

December 1, 1958

Aviation Week

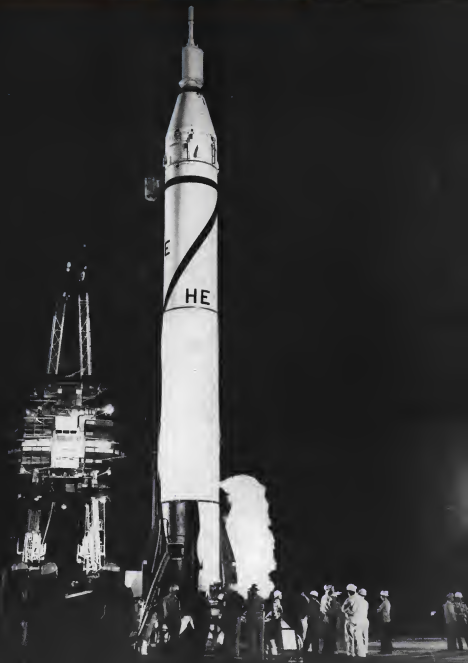
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AVIATION CALENDAR

- Dec. 8—Symposium on High Speed Testing sponsored by Raytheon Equipment Corp. Sheraton Plaza Hotel, Boston, Mass.
- Dec. 9-11—3rd Annual Electronic Circuits, sponsored by Kansas City Section, Institute of Radio Engineers. Marriott Anderson Hotel, Kansas City, Mo.
- Dec. 10—Test Quarterly Meeting, Society of Aircraft Materials and Process Engineers (SAMPE), Tacoma Division, Hotel Idaho Hotel, Washington, D. C.
- Dec. 11-13—Electronic Regional Meeting, American Chemical Society, Division of Analytical Chemistry, Fort Lauderdale, Fla. Electronic Annual symposium will conduct two symposia on Dec. 11. Invited papers on analytical chemistry and associated elements for students and teachers.
- Dec. 16—Fourth Converter, Amplifier Course, the Franklin Institute, Philadelphia, Pa. (Continued from Nov. 28)
- Dec. 17-19—4th Wright Brothers Lecture, Monroe Roy on French astronautics to month. Memorial Library Bldg., Smithsonian Institution, Washington, D. C.
- Dec. 17-19—1959 Annual Meeting, American Automatic Society, Hotel Vetter, Washington, D. C. Meeting will be held in conjunction with the 12th Annual Meeting of the American Assoc. for the Advancement of Science.
- Dec. 21-26—4th Eng. Change International Model Plane Meet., Mesa, Ariz.
- Jan. 13-14—4th National Symposium on Reliability and Quality Control in Production, Jefferson Hotel, Hotel, Philadelphia, Pa.
- Jan. 19-21—11th Annual Convention, High Speed Assn. of America, Villa Hotel, San Mateo, Calif.
- Jan. 26-28—27th Annual Meeting, Institute of the Aeronautical Sciences, Shattuck (Continued on page 6)

AVIATION WEEK Including Space Technology

December 1, 1959
Vol. 68, No. 22

Aviation Week with its emphasis on the latest developments in aircraft, space, and missile technology, is the most comprehensive and authoritative source of information available to the aviation industry. This year's edition, published by the American Institute of Aeronautics and Astronautics, Inc., is a must for all those concerned with the progress of flight. It contains over 1,000 pages of articles, reports, and data, covering a wide range of subjects from the design of new aircraft to the latest developments in space exploration. The publication is a valuable reference for engineers, scientists, and anyone interested in the field of aviation.

Subscription: Send subscription and check of \$10.00 to the American Institute of Aeronautics and Astronautics, Inc., 1801 Alexander Bell Blvd., New York 17, N.Y. Single copies: \$3.00. Payment in advance. Please allow 4-6 weeks for delivery. Please send no money orders or cash. Please allow 4-6 weeks for delivery. Please send no money orders or cash.

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Hermetic sealing protects entire mechanism against sand and dust, humidity, salt spray, fungus, and the field being measured. Unit has welded stainless-steel case, is 1 1/4" diameter by 1 1/4" long, weighs only 6 ounces. Standard ranges are 0-15, 0-25, and 0-50 psi, other ranges available.

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AVIATION CALENDAR

- (Continued from page 5)
- Jan. 10-11-12: Annual Meeting, New York, N. Y. Thomas Nelson, 1000, 1001, 1002.
- Jan. 25-26-27: 1978 Annual Meeting, Springfield, Massachusetts, Northern Ridge, University of Michigan, Ann Arbor, Mich.
- Jan. 27-28-29: Annual Technical Conference, Society of Plastics Engineers, Hotel Commodore, New York, N. Y.
- Jan. 28-29-30: Annual Meeting, Working Committee, sponsored by American Research Foundation, Illinois Institute of Technology, Chicago, Ill.
- Feb. 5-6-7: Annual Technical and Management Conference, Reinforced Plastics Division, Society of the Plastics Industry, Inc., Regency Hotel, Chicago, Ill.
- Feb. 15-16-17: Solid State Circuit Conference, sponsored by Institute of Radio Engineers, Professional Group on Circuit Theory, American Institute of Electrical Engineers, Committee on Electronics, University of Pennsylvania, Philadelphia, Pa. 20-21-22: 1978 Annual Pacific Coast VLSI Winter School, Champaign, Illinois, Penn. State Univ., San Diego, Calif.
- Feb. 26-March 1-1979 Engineering Exposition, Raffles Park, San Diego, Calif. All days require fee. 107 Land Tech Bldg., San Diego, Calif.
- March 1-5-1979 Western Joint Computer Conference, sponsored by Institute of Radio Engineers, American Institute of Electrical Engineers and Association of Computing Machinery, Fairmont Hotel, San Francisco, Calif.
- March 5-6-7: Flight Propulsion Meeting (the effort), Institute of the Aeronautical Sciences, Hotel Carter, Cleveland, Ohio.
- March 27-28-29: Space Age Conference and Exhibit, For information, Directorate Trade Dept., Los Angeles Chapter of Aerospace, 491 South Rock St., Los Angeles, 14, Calif.
- March 31-1-2: Engineering meeting on the future of action, sponsored by the American Society of Mechanical Engineers, Cincinnati, Ohio.
- March 18-20-21: Western World Engine Data and Congress, American Society for Metals, The Pacific Automotive and Aerospace Hotel, Los Angeles, Calif.
- March 23-24-25: National Convention, Institute of Radio Engineers, Columbia and Waldorf Astor Hotel, New York, N. Y.
- March 24-25-26: Technical Institute of Electronics, North International Science Center, Subject: Multidisciplinary Systems, Systems Engineering Society Bldg., New York, N. Y. Cosponsors: Department of Defense, Research Agency and Institute of Radio Engineers.
- March 31-April 1-2: National Aeronautics Meeting, Society of Automotive Engineers, 2020 United Commerce, New York, N. Y.
- Apr. 1-10-1979 Nuclear Congress, Municipal Auditorium, Cleveland, Ohio. For information, Engineers Joint Council, 25 West 10th St., New York, 22, N. Y.
- Apr. 7-10-1979 Working Shop and 40th Annual Convention, American Wildlife Society, International Amphitheater and Hotel Sherman, Chicago, Ill.
- Apr. 12-13-14: Power Plant and World Congress of Flight, Las Vegas, Nev.



Photograph of the electron orbit of a 50-electron double charged carbon ion as reported in a review article by J. J. Thomson and J. J. Thomson.

ELECTRODYNAMIC ORBITS

By the application of properly chosen alternating and static electric fields, electrically charged particles can be maintained in dynamic equilibrium in a vacuum against interparticle and gravitational forces. This is illustrated in the above photograph of the orbit of a charged dust particle. During the time of exposure the particle traversed the cloud over several times, yet it retraced its complicated path so accurately that its various passages can barely be distinguished.

The range of particles of different charge-to-mass ratios which can be contained in this manner is determined by the gradients of the static and alternating electric field intensities and by the frequencies of the laser. In the absence of static fields and for a given electric field strength, the maximum frequency required for stable containment of the particles is proportional to the square root of their charge-to-mass ratios. Thus, charged colloidal particles require the use of radio frequencies, atomic ions need HF frequencies, while electrons require the use of VHF and higher frequencies.

Under the confining influence of the external fields,

the particles are forced to release with a lower frequency of motion which is determined by the external field intensities, space charge, and the driving frequencies. If the initial thermal energy is removed, a number of particles may be suspended in space in the form of a crystalline array which reflects the symmetry properties of the external electrodes. These "micro crystals" can be reproducibly "fused" and re-formed by increasing and decreasing the effective electrical trapping force. These techniques offer a new approach in the study of plasma problems and even spectroscopy in what may be properly termed "Electrohydrodynamics."

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R-652 actuates the tailwheel power steering installation in De Havilland of Canada's famous DHC-3 Otter.



The R-652 operates at 10 gpm of maximum operating torque at 1000 lb in. Developed slip clutch integral to slip at 1300 lb in. Magnetic clutch will hold maximum load with 17 + mile applied R-652 weighs 1.2 lb.



Drawing courtesy De Havilland Aircraft of Canada, Ltd.

Design of Airborne large special actuator proved in rugged bush-line service

First installed on Otter aircraft some five years ago, the Airborne R-652 special design actuator has been subject to almost every conceivable extreme of bush-line operating conditions. Yet despite bitter cold, intense heat, wrenching, pounding and shock, it has

proved as rugged and reliable as the Otter itself. Says De Havilland, "We have used this actuator in service all over the world, from the Arctic to the tropics, with very little service trouble."

The R-652 typifies Airborne's capabilities in the design and development

of large special electromechanical actuators—rotary and linear. And whose requirements are not unique, we also offer a line of modular-type actuators, originated by Airborne to simplify design and specification. Write or phone for further information.

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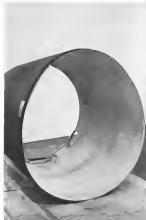
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ROTOLOK

Solve difficult problems with Solar all-metal honeycomb structures



Three lightweight, self-supporting cylindrical honeycomb structures—measuring 4 ft in diameter by 4 ft in length—will go into an afterburner ahead designed to withstand temperatures up to 2000 F.



Solar is an industry leader in producing difficult conical, elliptical and cylindrical honeycomb shapes for high-temperature applications.



Using Solar to stretch forming limits, all-metal honeycomb sandwich panels like this one for use in advanced aerospace structures.



Wedge-shaped honeycomb structures, like this Solar-Buck module for space support structure, fabrication and assembly techniques.

MILITARY AND AIRCRAFT designers are calling for more and more all-metal honeycomb structures—in an ever-widening range of intricate shapes and designs. Solar's unique core manufacturing techniques—plus advanced panel fabrication and assembly methods—produce all-metal honeycomb sandwich structures for almost any field.

Today Solar honeycomb structures are leading structural components where-

ever a high strength-to-weight ratio and corrosion resistance are required at temperatures to 2000 F. Materials used include: 904L SS, 7040, 17-7 PH, 304, Inconel alloys, 1-800 (H-8-25), AM-350, AM-353, A-286.

With years of active experience in the design and production of high-temperature module and structural components—and as a pioneer in the development of all-metal honeycomb

sandwich and high-temperature bearing shapes—Solar is particularly qualified to help solve your difficult design and fabrication problems. Write today to Dept. E-68, Solar Aircraft Company, San Diego 16, California.



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HERMETICALLY SEALED, LIMIT SWITCH

WITH STEPLESS ADJUSTMENT OF ROLLER ARM ACTUATOR



NOW YOU CAN get stepless actuator-arm adjustment in a light weight, hermetically-sealed switch for control of landing gear movement, bomb bay doors, tarrets and other aircraft components where dependable, continuous-free switching is essential. The Electro-Snap HI Series provides greater-application flexibility with infinite actuator adjustment through 14 degrees. Easy to install.

Electrically and mechanically, the HI Series has a minimum of 200,000 cycles. Electro-Snap construction permanently seals dry, inert gas inside the rugged case to assure positive performance with full electrical rating up to 100,000 ft. altitude. Highly resistant to adverse environment.

For full specifications, WRITE FOR DATA SHEET HN-12

CHARACTERISTICS

Contact arrangement	NO-NC-SPST, 4 circuit
	HS-4-1000
Pressure	100" OBI only fully closed
Movement differential	90°-180° only fully closed
	— 90°
Overtravel	90° min.
Operating force	4 lbs. ± 2-9
Quaranteed force	31 lbs. 7.2
Mechanical strength	1500 V RMS max.
Amplitude tolerance range	-100° to +250° F
Max mechanical cycles	200,000
Max electrical cycles	200,000
Electrical rating	10 amps @ 115/220 V ac 30 V dc incl
Influence of mounting and reset point	between each pole
Weight	8 oz max

MODERN DESIGN IN A COMPLETE LINE OF SWITCHES



EDITORIAL

The Soviet Nuclear-Powered Bomber

On page 27 of this issue we are publishing the first account of the Soviet nuclear-powered bomber prototype along with engineering sketches in as much detail as available data permits.

Appearance of this nuclear-powered military prototype comes as a relieving shock to the many dedicated U. S. Air Force and naval aviation officers. Atomic Energy Commission technicians and aviation engineers who have been working doggedly on our own nuclear aircraft propulsion programs despite financial restrictions, scientific snafus and top-level indifference. For, once again, the Soviets have beaten us needlessly to a significant technical point.

While this Soviet achievement is a truly remarkable feat, it is not beyond the technical state of the art in our own nuclear aircraft propulsion program. The difference lies rather in the top priority and unwavering support accorded the Soviet program by its top political leadership and the technical timidity, penny pinching and lack of vision that have characterized our own political leaders attitude toward the goal of nuclear-powered aircraft for both military and civil purposes.

This is a story that has become all too familiar to Americans in recent years, punctuated by the Soviet triumphs with the first medium-range ballistic missile in production and military deployment, the first successful ICBM launch followed by an ICBM test mission only shot in now more than 17 per month, and the two of September. That also could be the epitaph carved on the tombstone of this country's genuine technical development capability if we continue much longer on this course.

We are sure that there will be the usual chorus of good guys versus the high official planners attempting to "pull the wool" the existence of a Soviet nuclear-powered bomber prototype and coming smooth word-processed phrases to disprove its significance even if its existence is finally admitted, as finally it must be. For the time being on the Soviet score we know in official circles both here and abroad.

The credibility of the late "gas versus" has, of course, diminished in recent years because they used the same tactic and phrases to soothe the country before the aggression of Soviet nuclear weapons, intercontinental missiles, super sonic fighters, medium-range missiles, the ICBM and the Sputnik.

May Gen. Donald Keen, chief of the USAF ADC aircraft nuclear propulsion program, virtually let the cat out of the official bag in the quoted period after a speech in Washington last month by adding that it would not surprise policy makers if the Soviets flew a nuclear-powered aircraft before the end of 1975. This was like playing a hot on a horse man after you have watched it finish through fences and then found a bookmaker who doesn't have a phone.

With no secret warnings that the first world-wide demonstration of the Soviet nuclear plane would guarantee a major political blint. Gen. Keen also painted the image of cosmic acidity for our own slow progress at the sources who are really in trouble. There are the anonymous scientists headed by James Killian, scientific advisor to the President, who operate under a heavy veil of official secrecy and only last spring rebuffed a military-industry proposal to accelerate nuclear aircraft development on the basis of processing technical achievement.

Although not mentioned by Gen. Keen, former Secretary of Defense Charles E. Wilson also must answer for his

growing disorientation in 1975 of an atom-powered plane as a "strategic," a bird that has a long neck, big body and can fly but not very fast, and for his 1953 attempt to wipe out the entire aircraft nuclear propulsion program by cutting off its development funds. The late Harold G. York, then Secretary of the Air Force, disapproved that Wilson order by diverting some "ladder" USAF funds to the program. AEC also maintained its support.

Since word of the Soviet nuclear-powered aircraft began filtering through the Iron Curtain, the Pentagon has heavily revised an active program aimed at a nuclear-powered military aircraft known as the CANAMEL project. Mission of this aircraft is described by Gen. Keen on page 18. That of the political and military aggression of even a small fleet of nuclear-powered military aircraft, at Gen. Keen's dismissal, can prove indefinitely all the technical limits of the U. S. maintaining a continuous airborne alert and warning system combined with the capability of quick bombing of targets with sufficient range to penetrate 1,000 mi. or more and following up the attack with a high-speed, low-level penetrator with radar and atomic radar detectors to eliminate key targets needed to ensure success. It takes no military expert to appreciate the value of this capability in the hands of an aggressive, ambitious political dictatorship bent on world conquest.

The development of a nuclear-powered military aircraft must be much more than just producing a satisfactory power plant, and this is a phase in which we lag even further behind than in engine development. Every time the Israeli test was applied to the nuclear aircraft program, these in stages of success, showed aircraft system development to keep the precedent research alive.

That, with the Soviets now in the initial flight testing of a nuclear-powered military prototype and the Air Research and Development Command labeled only this month to make a decision on prototype construction of a nuclear aircraft, it is most to expect the most conservative technical analysis that we see at least four years behind the Russians in this critical area. Development of such a new and technically radical weapon system to full utility capability is a long, painstaking and often stonewalled process on both sides of the Iron Curtain. But with such a clear-cut lead, we now expect the Soviets to exploit their nuclear-powered aircraft for political warfare long before it has developed a sound military capability. There already are indications that a nonstop, non-extended flight several times around the world is being planned by the Soviets with this type aircraft. And, how much political force will be exerted on this aspect on our allies, the neutrals and our enemies?

During the past few years, we have heard much from our political leaders on how much we can or cannot "afford" for the defense of this country.

These were the same years that we have been laboring with vigorous efforts to cut the strength of our military forces to bring and perpetuate our military future by, subtle slashes through the nation's and industrial budget.

There were the same years the Soviets appeared first with their huge intercontinental and medium-range bombers, their medium range ballistic missiles, ICBM and Sputniks.

In view of these Soviet technical achievements, it is most pertinent to ask:

How much longer can we "afford" this kind of leadership and still survive as a free nation?

—Robert Hart



GO . . . NO-GO

Automatic checkout equipment is a project of J. G. Ferguson, Senior Staff Engineer, Stavid Engineering, Inc.

Mr. Ferguson has specialized in the development of frequency standards for radar and other navigation systems, field transmitters, receiving apparatus, radio frequency test displays and many other test and measuring devices for electronic equipment. His current work at Stavid is to develop equipment for reliability studies and automatic testing of electronic systems. Mr. Ferguson is one of a team of Stavid scientists and engineers who are applying their knowl- edge from contract through production to projects of major importance to the defense and progress of our country.

In Stavid's objective requirements, automatic, scientific development and manufacturing teams are producing a wide range of electronic systems for all branches of the military. A typical project is the development of an Airborne Search, Homing and Terrain Clearance Radar System.

OTHER STAVID PROJECTS INCLUDE:

- Air Phase and Submarine Antenna Systems
- Electronic Countermeasures Equipment
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- High Power Air Search Radar System
- Radar Test Banking System
- Missile Guidance Systems
- LAHCE Weapon System

STAVID Engineering, Inc. Fairfield, New Jersey

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Washington Roundup

Defense Budget Battle

Department of Defense Fiscal 1960 budget was due to be presented to President Eisenhower over last weekend at his Augusta, Ga., golfing retreat in Defense Secretary McElroy and his entourage. Bureau of the Budget has taken the strongest stand in past war years in shaping specific military programs he saw. Budget Bureau normally gives military requests a final veto and how then to allocate money for projects within the services. Now, however, Budget Bureau is ordering specific projects cancelled by the military.

Among the programs already scrapped are the \$149 million F-105 program specified for development of a better strategic missile and the Convair F-106 program all-weather interceptor program. Still mangled, with a Budget Bureau veto but a strong Defense Department rebuttal, are the North American B-70 and F-105 Mach 3 bomber and interceptor development programs and the Convair B-58 Mach 2 bomber production program. Present plans call for Mr. McElroy and his deputy, Donald Quade, to do the major Fiscal 1960 budget presentation before Congress during midweek in the Pentagon and producing their only on specific request from Congress.

Military Procurement Law

At the same time, both Sen. Lyndon Johnson (D-Tex.), Senate majority leader, and Perkins McGee, Assistant Secretary of Defense for Supply and Logistics, say they favor a review of the military procurement law. In the new Congress with the primary objective of cutting lead time to expedite advanced weapon development and production.

Legislation, introduced in the past session and due to be reintroduced in the new session by Sen. Everett S. Mitchell (R-Minn.), aims to accomplish this by establishing performance specifications, encouraging fixed price and incentive-type contracts and encouraging lead time contracts from negotiation (AW Aug. 18, p. 20).

Johnson had outlined the objectives of the Mitchell bill. He stated in a letter to Mitchell that cost and time between him made it abundantly clear that steps must be taken to assure procurement procedures if modern weapons are to be obtained at the lowest possible cost. Johnson and his aides the new session will produce legislation that "will go far toward changing the obstacles which delay the only procurement of our new defense arm."

McGee wrote Mitchell: "We are vitally interested in progressive procurement legislation and especially in methods for reducing the lead time required for developing and producing new military weapons systems."

Saltzman's legislation reflects the views of J. Sterling Livingston, professor of business administration at Harvard Graduate School of Business, and Frank Fox, president of General Dynamics Corp.

Divided Opinion

Selfishness to the Mitchell procurement bill in other quarters is divided.

• Strategic Industries Association endorses the bill's provisions to encourage competition, negotiation in an alternative to selected bid contracts and to extend security-type contracts from negotiation. Other small business inter-

ests, however, charge that the bill's policy of expanding weapons system type procurement "will virtually eliminate small business from weapons procurement."

• Thomas Caggs, chairman of the Recognition Board, will oppose watering down the negotiation law by exempting fixed-price and incentive-type contracts. Robert Berber, general counsel, has indicated that Department of Defense will firmly support Caggs' position.

• U. S. Chamber of Commerce will give general industry support to Saltzman's measure. The Chamber opposes the bill's provision which "rejects" price competition to give preferential treatment to small business in the award of subcontracts but is not expected to make an open fight against it. Stating his simply states a policy of preferential small business treatment, but is not contradictory.

Vandenberg: Briefly Opened . . .

Launch of a Douglas Thor intermediate range ballistic missile inaugurating the operation at Vandenberg AFB, Calif., will be an open shot according to Morris Bender, Assistant Secretary of Defense for Public Affairs. Initial launch is scheduled to take place over the Pacific Missile Range only this month. It will be launched by a ship from the 70th Strategic Missile Wing and will be the first ballistic missile fired from the West Coast. In addition to missiles developed by Strategic Air Command, other projects assigned by the Advanced Research Projects Agency and NASA will be conducted at Vandenberg and the naval missile base, Pt. Arguello, Calif.

. . . But Tight Security Planned

Despite plans for a public program that permit public call for a tight security but to be clamped on the Pacific Missile Range-Vandenberg complex. The program was approved last week by Ray Allen, J. P. Moore, range commander of PMR. Moore cited the cost of maintaining secrecy as one of the chief advantages of the location of the new missile facility at Pt. Arguello and at Vandenberg and said that possibly will be no announcement of what number it is to be fired from the complex, when they are fired, as age information containing sources or failures. "We simply cannot afford to make available to Russia the amount of information which has been published in the past," he said. Moore, whose Pacific Missile Range organization has an reputation for accuracy on landings from Vandenberg AFB also said he expects the Pacific range to pass into a higher operation than the Atlantic missile range at Cape Canaveral, Fla.

He added that PMR will be no war compatible with either the Atlantic range, or the White Sands, N. M., range, but will complement them.

Hazardous Contracts

The President will say Congress to pass legislation authorizing Department of Defense to indemnify contractors working on hazardous production contracts. The Department asked for the legislation this year, but the Armed Services committee failed to act on the measure. There already is authorization to indemnify contractors working on military research and development contracts.

—Washington staff



AVIATION WEEK ARTIST'S conception of Soviet nuclear-powered bomber shows large engine powerplants suspended from pods and wing under delta wing; conventional turbojets with short takeoff wheelbarrow on wingtips, and 279 ft fuselage to rid in collision protection.



AVIATION WEEK ARTIST'S conception of how Soviet nuclear-powered bomber prototype looks in three view. Note engine mount head up gear with outriggers folding up into wing from a single and its high-speed wheel. Nuclear powerplant an airbus are approximately 7 ft in diameter. Radiation shielding details are not available, but double shielding concept is used with heavy shielding around nuclear powerplants and additional shielding protecting crew compartments.

Soviets Flight Testing Nuclear Bomber

Atomic powerplants producing 70,000 lb. thrust are combined with turbojets for initial operations.

Washington—A nuclear-powered bomber is being flight tested in the Soviet Union.

Completed about six months ago, the aircraft has been flying in the Moscow area for at least two months. It has been observed both in flight and on the ground by a wide variety of foreign observers from Communist and non-Communist countries.

In its initial flight testing, the new aircraft is powered by a combination of nuclear and conventional turbojet engines. Two direct air cycle nuclear powerplants are housed in 36-ft-long nacelles along on short pylons about midway out on each wing. These nuclear powerplants, with 6 ft diameter air intakes and using small but high power reactors to replace the combustion chambers in the turbojet cycle, produce about 70,000 lb. thrust each.

They are supplemented by two air-cooled turbojets installed in nacelle pods fitted with short wheelbarrows, to provide about 15,000 lb. thrust each for takeoff performance. The conventional, phenolic-fueled turbojets are used primarily for safety purposes during the early flight test program of the nuclear powerplants. In later versions of the aircraft, they may be retained for high speed dash performance or replaced by two more nuclear powerplants after their reliability has been proved in flight.

The Russian nuclear-powered bomber is not a flying test bed in the sense that earlier U. S. Air Force and Navy programs had called for installing a nuclear powerplant in a conventional aircraft such as the B-16 or Saunders Roe Pioneer flying boat solely for test purposes. The Soviet aircraft is a prototype of a design to perform a military mission as a continuous airborne alert warning vehicle and aerial launching platform similar to the USVF CAMAL, power for which General and Lockheed are now making design studies (AW Nov. 16 p. 77). The CAMAL mission was recently described in detail by Maj. Gen. Donald Koss (see below, p. 38).

In its present configuration with both nuclear and conventional turbojets, the Soviet aircraft has a performance capability in the high subsonic and supersonic speed ranges with its ramp-limited only by engine component life and crew endurance.

The Soviet nuclear-powered plane has a fuselage about 279 ft long and a 7 ft wingspan. The delta-type wing is sweptback on both leading and trailing edges. From an initial angle of 50 deg. as upstroke at the wing root, the leading edge changes to about 35 deg. sweep

at the forward engine pylon mounts and beyond to the wingtips to produce a "cooled" effect similar to British bombers such as the Handley Page Victor and Avro Vulcan. Trailing edge of the wing is swept about 15 deg. The delta-type wing gives a relatively thin, high-speed aerodynamic cross-sectional performance peak for this design in the Mach 2 speed area.

Vertical tail area about 22 ft above the fuselage. It is a typical "rod" type fin and in Soviet diagrams to ensure good directional stability. Horizontal tail surfaces have a span of 10 ft and are swept back at about the same angle as the forward wing panel. This apparently is kept well clear of the nuclear powerplants either both by placement high on the fuselage and by space length.

Aircraft has a gross weight of about 180,000 lb. and a wing loading of about 112 lb. per sq. ft.

The direct air cycle nuclear powerplant has been described in some detail in Soviet technical publications (see diagrams on page 26). In a text published last year in the Military Press of the Soviet Defense Ministry entitled "Applications of Atomic Engines in Aviation," the direct air cycle powerplant is described as follows:

The simplest is a design that differs from the ordinary turbojet engine only in that the combustion chamber is replaced by a reactor.

This simplest design permits obtaining the highest specific performance parameters. In this case, the air duct

F-108 Avionic Contract Awarded In Hotly Contested Competition

Washington—Hotly contested competition to select a contractor to develop the Mission & Traffic Control avionics subsystem for the F-108 Mach 3 intercepter was won last week by a team headed by the Federal Division of the International Telephone & Telegraph Corp. after Air Force regulars this first choice submitted by North American Avionics-Collins Radio Co.

In telegram received by at least two of five major manufacturers and teams that competed, North American said that procurement of this subsystem from International Telephone & Telegraph Corp. "would be to the best interest of the service avionics program."

North American's first choice for F-108 flight control avionics contracts also has been designated by Wright Air Development Center acting as task award authority to Weapon System Project Office, and the matter has not yet been resolved.

The F-108 aimed also given International Telephone & Telegraph (ITT) a possible edge in competition for the Mission & Traffic Control subsystem for North American's B-70 Mach 3 bomber.

Mission & Traffic Control, is similar to earlier communication/navigation/identification (CNI) package but also includes additional functions. On the other hand, North American might recommend another contractor for the B-70, one of whose Mission & Traffic Control avionics contracts will be awarded, under the F-108, in order to have a backup for both programs.

Action of WADC in designating two of North American's F-108 avionics teams, offering in a position among three sources selected by weapon system managers that is causing some concern within the industry. Solicitors' bottom approach are told not to submit their proposals to WADC laboratories or other Air Force user until while the weapon system manager is making his evaluation.

Adhered to Policy

One company not involved in the F-108 program but bidding for a B-70 intercepter, says it has adhered to the policy and has not sought to advance its case behind the scenes with WADC Laboratories, although it has contacted other key decision makers. If the F-108 establishes a pattern of the future, the spokesman says his company may be forced into behind-the-scenes efforts to win its competitive efforts.

Mr. Gen Victor B. Hagen,

WADC director of system management, told Associate Press Air Force policy that subject has never been put in front either to industry or to WADC Laboratories. He adds that it might be well to do so in order to clear the air.

WADC's Communication & Navigation Laboratory disapproved of North American's selection of Collins Radio Co. because of its desire to make itself one of Air Force sponsored development and to achieve maximum identification, according to two Air Force spokesmen.

Crisis of Matter

One of the major aspects to be the high frequency (HF) data link contract which Collins proposed to use. Hughes Aircraft Co. is developing a new HF voice and data link communication system under sponsorship of the Communication & Navigation Laboratory. The winning International Telephone & Telegraph proposal included use of the Hughes system. Collins proposed to use its own single channel system developed under Rome Air Force Development Center sponsorship with an HF data link developed under Navy and Army sponsorship.

Collins declined to comment, apparently, his line of having its chosen for the B-70 and F-108 Control and Intercept. It is known, however, that Collins has been primarily a Navy avionics supplier as the past and has had difficulty convincing the Air Force perfect for avionics communication and command equipment. Company is building

the Communication Navigation Identification package for the Republic F-105, but this was sold directly to the Republic. Another, the Collins AN/ARC 55 airborne single channel set was sold to Rome Air Development Center as part of an overall package that included considerable ground equipment.

Air Force spokesmen say WADC made it clear to North American that the F-108 Mission & Traffic Control package should be compatible with the HF digital data link system being developed by Hughes, which Air Force hopes to use on a variety of aircraft. One spokesman says the specifications North American sent out to bidders who made this point.

In any case, Collins chose to bid its own HF voice and data link system which it apparently believed to be preferable to the new audio development by Hughes.

When WADC stated the Collins selection, its engineers were invited to make a technical presentation to the Communication & Navigation Laboratory and Weapon System Project Office personnel to try and convince them of the superiority of the Collins approach. This failed, although an Air Force spokesman concedes that Collins had an uphill battle against an Air Force sponsored development.

A spokesman for WADC's Flight Control Laboratories says the question of using Air Force sponsored development is not resolved at all in its view of the North American contractor choice. He points out that Flight Control Laboratories operates only a small fraction of the total development efforts carried out by industry and that it is eager to use the best individual and ideas, regardless of where or how developed.

Navy Terminates P6M Program

Washington—Navy last week cut its order for Martin P6M Seamaster jet supersonic from 24 to a total of 14 aircraft in one of the first contract cancellations of Administration plans for a high speed 1960 defense program.

A Martin Co. spokesman said the reduction in the Seamaster program probably will bring production of the aircraft to a halt within 10 to 11 months and force the company to lay off about 5,000 employees.

Present Navy development contracts do not include any other high speed supersonic. "Virtual end of the Seamaster program also means the number of weapon delivery systems available to the U.S."

Concept behind the Seamaster was to have a high-speed, maneuverable, supersonic aircraft capable of high speed maneuvering as well as bombing

and could operate from Boeing bases in the open sea.

Sea P6M aircraft powered by four 16,000 hp thrust Allison J71 turbojets have been delivered and eight P6M-1 Seamasters powered by 15,000 hp Pratt & Whitney J75 will be produced before the contract is terminated. These 14 aircraft will be operated together as a squadron.

The first six developmental aircraft cost \$175,000,100. The last eight are expected under a \$134,445,000 contract originally calling for 18 aircraft. This figure will be reduced somewhat as ten mission requirements.

Two Seamasters were lost during development program, the first with a loss of four lives. In the second crash, the crew of four left the aircraft safe during a steep loop at nearly twice normal speed.



Air Force's GAM-72 Quail decoy missile developed and manufactured by McDonnell Aircraft Corp. has been launched from Boeing B-52 and B-57 bombers and recovered by parachute. Quail underwent capture and glide flight tests at Holloman AFB, N. M.

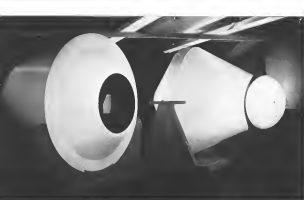
McDonnell Unveils Quail GAM-72 Decoy Missile



Quail's size is limited by the dimensions of the launch bays in which it is designed to be carried. Upper vertical tail surfaces (left) are hinged to reduce height while in bomb bay. Upper extremities projecting from wing leading edge may be for electronic countermeasures.



Quail photos are shown in forward and side views. Developed in active version of General Electric J75, aircraft version is used at 2,600 ft. thrust at sea level. Unusual engine or intake design may be to achieve optimum air ingestion during deep from bomb bay.



SCHEMATS of two GE capsule designs show similarities in configuration to GE's more recent free ballistic vehicles. Capsule of left is for first man. Mockup at right represents a GE approach to the NASA Man in Space program.

Space Technology

North American, GE Make Joint Manned

By Evert Clark

Washington—General Electric Co. and North American Aviation Inc.—cooperated at a recent Air Force man in space capsule study—have teamed up as an effort to win the manned satellite competition now being held jointly by National Aeronautics and Space Administration and Space Advanced Research Projects Agency.

New details of General Motors's satellite design concepts were revealed by H. W. Rugh, general manager of the company's Missile and Space Vehicle Division, at the Redding Lecture delivered at Princeton Institute.

These concepts grew out of GE's development of the Atlas and Thor missiles, two years of study of manned vehicles of this category, and experience with the Atlas vehicles that guided the Atlas which is the most likely launching vehicle for the NASA capsule, basically with recovery of man, comes at sea and the Air Force Phase I capsule study, which was allowed to expire when NASA took over the man in space program.

Although NASA's specifications are quite detailed, and reflect constraints to a specific approach (AW No. 24, p. 28) that well define limits that studies made be runs of the competing concepts over recent months, many of GE's design parameters are close enough to the capsule NASA is seeking to be of interest.

Highlights of Plan

Highlights of GE's approach as detailed by Rugh indicate that:

- Launching from Cape Canaveral, Fla., possible will be to the southeast since this would put the first six or seven orbital orbits in the centers of the U.S. and considerably increase chances of a landing on or near the coast, thus greatly facilitating the search and recovery problem. All missile launches have been to the southeast along the Atlantic Missile Range, but have seldom and some satellites have been launched in more northerly directions. Southern launch would give only two orbital paths in the centers of the U.S. each in the flight.

Although the southerly angle

would require new range facilities and reorientation of missile guidance systems, Rugh said it may well be worth the expense.

- Impact dispersion can be held to less than 100 mi. and search sweep width of more than 100 mi. are possible, giving an extremely high probability of successful location of the capsule and its occupant within 24 hr. after return to earth. "NASA's minimum time requirement for the capsule to this point is 12 hr."

First of drops and phases would be used for search and location. Although this is a more ambitious undertaking than that used for man in space recovery, Rugh said "the design approach taken will be one to emphasize man's safety."

Problems of location and recovery "are well in hand," he said. "We have repeatedly performed successful flight data recoveries with our (Atlas and Thor) data recovery capsule."

- Strongest postflight program of qualification and reliability testing will precede launching of man. This will include drop tests, impact tests, environmental tests, etc., and will "be more



CONSOLE of variable drag capsule mockup as demonstrated to Maj. Gen. E. F. Felt, USAF deputy director ballistic vehicles, AMRL. Seat at center is raised to pilot, sports to engine position (right). Note Maj. Gen. Felt's hand on control lever (left).



Gen. E. F. Felt, USAF deputy director ballistic vehicles, AMRL. Seat at center is raised to pilot, sports to engine position (right). Note Maj. Gen. Felt's hand on control lever (left).

Satellite Bid

strongest drive on any program of the past or present."

- Five flights probably will be ballistic trajectories short of orbit and carrying animals to prove out the system. First orbital flights will be with complete but unoccupied capsules.

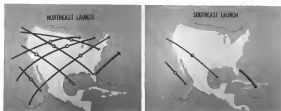
- Pure ballistic, high-drag shape has been chosen because it offers the highest reliability and safety, since there is not yet any assurance that a pilot can control glide or variable drag vehicle as yet, and an ejection. Later vehicles will be glide or variable drag shapes, he said, they offer maneuverability. High-drag ballute shape also offers the first cut approach from the standpoint of hardware development.

Pure ballistic design has the disadvantages of higher acceleration on both entry and emergency escape during launch, but the gravity loadings are within tolerable limits if entry angle is proper. Angle of 2.8 deg. for cone plus, launch acceleration is just above 12G.

Severe design conditions result from the need to shield the occupant from heating. For a three degree angle, he

OVER-ALL view shows variable drag capsule mockup under study by GE.





MAPS compare routes of daily flight orbits across U.S. with a northeast launch (left) and a southeast launch (right). Northeast launch would require additional reorientation of tracking facilities and added expense, but enhanced recovery opportunities are proposed in paring the cost. Both use Cape Canaveral, Fla., as the launching site.

satellite, total loading at the nose of the CR design is 7,500 British units, and peak rate of heating is 100 Btu/s ft².

General Electric studies favored firing a rocketed downward and backward from the direction of flight to get the vehicle out of its 106-135 sec orbital orbit and onto a sub-orbital trajectory.

Integrated vehicles of this rocket and the proper firing angle are of funds initial investigations. Vega will serve two missions, ranging from the time of firing to time of impact and drop-out of the impact.

Larger atmospheric densities deeper into and higher, but increases peak G load. The 125 g peak, which is currently considered "to be uncomfortable but tolerable" on a well-supported man, has its required velocity to 1,500 fps. This required velocity puts the proper firing angle would give a range to impact of 2,000 miles and a deceleration about

five intended impact point of about 75 g.

Design competition in black North American and GE engaged in a five-month study, and was aimed at determining several factors, such as vehicle G loads and heat input requirements, etc. Each company received a the neighborhood of a quarter of a million dollars on contract and provided considerable funds of its own. These information from the Air Force studies has been made available to NASA.

Fairley Aviation Work Hurt by Order Lack

LONDON—Lack of aircraft orders and the need to spend more on research and development without government support has hurt Fairley Aviation Co. A financial review conducted by Chairman and Managing Director Geoffrey Hall said in his annual report.

Subsidiary companies in Canada and Australia are showing good results. Hall said, and in consultation with other subsidiaries, including nuclear power, atomic engineering, plastics and air photography is proving off. But aircraft work is a forthcoming, especially from the government—France will be forced to close down some plants, he added.

Some of the company's projects have finished due contracts to lack of interest from the government, Hall noted. These include the Pirella satellite and the Delta 2 aircraft. Work in hand includes design and development of an air tank module for the zero and an order for one Rutanair VTOL. Company also hopes to receive a Canadian order for an Ultra Light helicopter, he said.

Referring to the Rutanair project

Hall said the company had spent \$2.5 million on its development in the last year, and was seeking a number amount for general research and development due.

Although Ministry of Supply has approved Rutanair, Hall said, despite the fact for government backing has been protected and "we cannot allow this long delay be entirely ignored as to the outcome."

Unlike the government project area, financing some "outside" backing will be necessary, followed by a number of the Rutanair in another company, he added. Rutanair Aircraft Corp. is U.S. based.

Later, declines to say how much it has asked from the government for the venture but indicates, otherwise estimates the company would ask \$5 to \$10 million if the government would contribute \$4 million.

Nozzles Formed By Plasma Arc Heating

New York—Plasma arc temperatures to 15,000 deg. Kelvin are being utilized to fabricate solid propellant rocket nozzles and throats, and to cast representative nose cones with integral and other refractory coatings. The development of the process is the Liado Co. Sweden led a division of Union Carbide Corp.

In addition to high temperature waste applications, the plasma arc processes are used to heat alloys in the electronics field in forming transformer grids and other methods, as tube cast joints. The company claims that refractory, refractory, refractory, refractory, refractory and other metals can be fabricated in one, heated fluidized bed of refractory at 1,000 to 1,500 deg. C.

Bid Reopening

WASHINGTON—Reopening of bidding on a \$40 million B-70 design, single-engine rocket engine contained within by Advanced Research Projects Agency Design to Key Johnson (AW Nov 24 p. 28), apparently applies to building of the first engine.

Rocket Division of North American Aviation Inc. is continuing to design the engine but reopening the bidding by National Aeronautics and Space Administration would mean another development would be needed for prototype.

Feasibility that a redesign of space program under Henry H. Hays and NASA engineers will lead to acquisition of the only other commercial launchers in the world is also still alive. This is the result of eight major studies reported last week by Air Force Research and Development Agency and NASA. The ARPA's space work is part under the production of NASA, NASA launchers could be selected for the Jupiter class. These launchers would have the capability of developing with an 800,000 lb thrust also could be changed.

Aircraft, Avionics Assns. Begin Wage Dispute

WASHINGTON—Aircraft and electronic industry associations began a legal offensive, with unions begin to back which will force the Federal Government to lead whether electronic manufacturers are part of the aviation industry.

Under present regulations, aviation wages paid by electronic companies doing defense business are about \$1.60 per hour or around approximately 30 cents lower than the legal minimum in the aircraft industry. Aircraft firms contend that this minimum wage after cost price then it is a disadvantage when bidding against aircraft firms for guidance system contracts and other electronic and semi-conductor equipment relating directly to aircraft and missiles.

Aircraft Industries Assn. has asked that the Secretary of Labor use his authority to act on minimum wages for government contractors, provided he is under the War Relocation Act and to the minimum wage for contracts with companies engaged in aircraft and missile work.

Electrical associations such as machine and electronics are not included in the petition but guidance, navigation, control systems and related equipment are.

The aircraft industry's two largest unions, the International Assn. of Ma-

chines and the United Automobile Workers, also have submitted similar petitions to the Labor Department.

Electronic Industries Assn. has stated with a proposed deal the present ruling for the aircraft industry, established in 1953 by the Secretary of Labor, be continued.

Many fear of the electronic industry that a sudden 20 cent per hour increase in minimum wages on government contracts would have overwhelming pressure for wage increases in its commercial work.

ARDC and Industry Study Space Designs

WASHINGTON—Studies of seven general types of orbital space stations are being conducted by industry and Air Force's Air Research and Development Command.

Except for work already underway, such as space projects and the Dyna-Soar orbital station studies, ARDC research is limited to its studies, space work generally to studies in support of Advanced Research Projects Agency or National Aeronautics and Space Administration interests. Work is already done, project is for a weapon system design studies which would be approved by one of both of these agencies.

Space station work, under study in the past industry ARDC approach, were funded by ARDC, used to be directly asked and some points—see the following:

- Strategic orbital system for operations over the earth.
- Global surveillance system.
- Twenty-fourth reconnaissance satellite.
- Strategic laser system for operations in the moon's area, probably in a home orbit.
- Lunar observation.
- Strategic anti-aircraft system.
- Satellite intercepter.

News Digest

Therapeutic research on winging aircraft, designed by W-11 is being developed by U.S. Navy by General Aviation at Buffalo, N. Y. The aircraft will be a replacement for the General Aviation W-12 Tracker and will be powered by the Allison turbo-prop engines. W-12 will operate from carrier and will have considerably more range than the Tracker. Detection gear will be mounted in a more charged indoor stop the landing.

New parachute, with four air-like separate cloth sections that open like a helicopter rotor, has been developed by

Flower Parachute Co. Victims ring their, designed for accurate in-drop of material and also in landing and for jet planes, in being evaluated by armed services and two aircraft manufacturers.

American Machine & Foundry Co. has been awarded a \$1,100,000 contract by the Defense Dept. of Air Research and Development Command for design and development of Titan intercontinental ballistic missile underground launching system (AW Sept. 15, p. 29).

Annual savings was contained by Ernest R. Borch, chairman of the Ford Motor Co., at the annual World's Club dinner in New York last week. Workable for simple savings at 10% or 15% increments, the annual concept applied to more complex, savings systems could lead to technical stagnation, prolonged development delays and inefficiency, Borch said.

General Aircraft has formed a space project, "a study of the design, engineering and research necessary to bring together a space platform concept, such as space and its exploitation.

British Navy has presented Scimitar reconnaissance following a crash during a test, training flight. Pilot was ejected but none of the aircraft was lost.

Capital Airlines last week announced plans to lease their Vickers 512 jet-prop aircraft from Continental Air Lines for use in scheduled service between Dec. 14, continuing in April 1965. The company is planning to lease 15 Capital will operate the three aircraft on its New York-Chicago and Washington-Chicago routes. Lease contract will run from Nov. 25 to April 25, with an option to renew if that time. Aircraft configurations include 12 seats and a forward lounge. Capital's move will be pointed on the top-side of the package but the plane will continue to run Continental's magnets.

Thiokol Subrose Award

Thiokol has awarded Thiokol Chemical Corp. a research and development contract for a space propulsion system of solid propellant rocket engine of solid propellant, General Aviation Corp. for another propulsion system. Thiokol was made the Thiokol propellant because of work on high energy solid propellant technology of company's Titan, Minuteman, and other solid propellant rockets. Thiokol was not expected to be a high energy solid propellant rocket designed to maintain by long time membership of more which will be fed through liquid tubes.

OUTWAY of GL two air engine work shows timing arrangement of aircraft. This is the steady flow of the engine and the components have their heads to it.

AIR TRANSPORT

Airline Strikes Portend Series of Battles

Third-crewman issue gets first showdown in Eastern strike as labor troubles plague airline industry.

By Glenn Garrison

New York—Airline management and labor squared off last week in what threatened to be a series of battles over stalled and strike-ridden jet age transport negotiations.

Eastern Air Lines, struck by its flight engineers' last week in the first serious showdown in the third-crewman issue, and also hit by its mechanics' refusal the same day, was dragging its feet for the long pull. It canceled its Dec. 1 management of Lockheed Electra service and was investigating ways and means by possible elimination of additional Lockheed deliveries, suspension of new fleetings programs and holding deliveries at various points.

A strike threat by National Airlines' mechanics organized in the same and the same agreed to jet contract including pay raises totaling 44 cents over the three-year term of the agreement.

From World Airlines' pilots was still that done at work as a result of an International Air of Mechanics strike Nov. 21 against the airline and wages. A federal mediator was in New York City trying to find some solution to the dispute, and through him the same said a new offer.

Neither Eastern nor its captains showed signs last week of softening their positions on the crewman issue, which was brought to a head by pilot action between the airline and its pilots that flight engineers by pilot action. The flight engineers believe that if they hold out for 15 days then will have Eastern as a position where it will have to go in. If it doesn't, the engineers are prepared to go on as long as may be necessary, it spokesman indicated.

Eastern's decision on the new full local recommendations of a Philadelphia Emergency Board.

The new plan is a major threat to industry labor relations, because there is apparently no solution that can reconcile the pilots and engineers' problems. Unlike the mechanics' contract dispute over wages, their appeals to a labor board for negotiation.

Later, and the engineers were to court over the matter last week. The airline asks an injunction and also demands of 55 million plus \$1 million for extra day the strike continues, the engineers ask to prohibit the Eastern to operate with its pilots.

The crewman issue also brought American Airlines last week to the brink of a pilot strike, but a restraining order American got from a

federal court. Hearing on the airline's petition for a permanent injunction was scheduled to be held last Friday.

Eastern's mechanics struck within an hour of its engineers, but the mechanics showed no disposition even in the form of the crew. Eastern chapters of IAM, Flight Engineers International Association and Air Line Stewards and Stewesses Association have formed a contract to each other in dispute with management, but the mechanics' strike was over issues between their own union and Eastern, it was said. The new rule and recommendations, the airline said, were prepared to observe the pocket books of the other unions.

The Eastern council of the three unions was under consideration earlier this month as a model for an industry-wide negotiation. The legalistic subcommittee of the AFL-CIO group was also called a meeting in Washington that was attended by representatives of the Transport Workers Union, Brotherhood of Railroad Clerks, the Air Line Pilots, flight engineers and mechanics, representing a total of 93,000 airline workers.

The meeting was a counter move to the airlines' push between American, Eastern, Capital Airlines, United Air Lines, Pan American World Airways and TWA, established several weeks ago. This agreement with the pilots was in an effort to block the airline's strike of mechanics, the airline said from

deserted business. It was noted in the 37-day Capital mechanics strike which ended after a wage agreement (AW Nov. 24 p. 17) and a further note in the current strike. In light of, however, has not been established.

Two local severe curbs also were having serious problems last week. Stewards of Lufthansa Airlines went out, but the airline continues full operations. West Coast Airlines mechanics set a strike deadline during the week, but the dispute was settled without proceeding the company a month. Lufthansa's stewardesses on a mission of ALISA, which is a subsidiary of the airline pilot's union. The pilots' contract ended last, but the two unions were meeting last week to try to find a solution which would be offered to Lufthansa management.

The striking mechanics are prepared for a long battle if necessary, but their situation seems on the local level. Discontent has been reported between groups within these fields. In the case of Capital Airlines, the negotiating committee of the IAM local asked A. J. Harte, president of the international union, to take over negotiations. Harte and Capital president David Babin previously conducted the negotiations which led to the strike's end.

Complete unanimity, do not exist among airline management despite the united and parts. A number of airline executives, for example, have privately criticized Northeast Airlines for agreeing to a 41 cent increase with its local IAM chapter at a time when Capital's not holding out in the threat of a strike for 15 cents. Final Capital settlement satisfied the Northwest flight.

American's pilots also did seem angry in their strike decision, but it was not only the crewman question the "key man" in the situation. Others are money, rules governing working time, air time, and scheduling, according to the pilots.

American, however, is losing its in previous labor act provisions have not been exhausted in including the dispute that leaves a strike would be illegal. The airline executives have been so real negotiating yet on the continued issue.

One solution to the third crewman strike that has been proposed by ALPA is several airlines to provide a fourth man in the cockpit. The pilot's union doesn't need the presence of a mechanic-in-flight engineer as long as there is a third pilot man on the crew. This would allow the pilots' demand, such as the more of air time and more pay, and capable of handling the controls be on only as set redesign.

It seems unlikely, however, that the idea of carrying a fourth crewman along for the ride would have the ef-

fect of attracting much airline support. American and ALPA proposed for a meeting which had been scheduled for last week, but the airline said it to have been reported at the hearing on Friday. The airline said the strike notification, which ended a Nov. 15 deadline, had moved unexpected Nov. 22 and had "caught us off base."

Pan American, meanwhile, was going ahead with its transatlantic jet service flown by supersonic pilots. The crew's last work was operating contract negotiations with Transport Workers Union, which represents Pan Am's mechanics. The contract expired today. Pan Am's pilot contract runs through Dec. 31, 1958.

The Independent Airlines Association last week and 20 representative carriers could offer 3,000 seats a day to ease the traffic situation brought about by the strikes. Two-fifths of the association's members' fleets are low-speed aircraft suitable for long haul business, the association said.

At midweek, National and Northeast Airlines reported a list of bookings but each said it could provide all the seats it could in its own grounded fleet. Pan Am's spokesman said that the situation had arisen at a time when the carrier's fleet was geared for peak seasons and it could cope with the extra

load on New England routes as well as the Florida one.

National was adding sections, but down to the ground staff and said it could take care of Eastern's extra demand. Pilots regarding the strikes and reasons of effort, including No. 1 terminal, has moved dozens of seats from the airline transportation, National said.

United Air Lines reported it was cramped with tighter bookings in addition to what it would normally get of TWA's diverted traffic. Passengers seemed to be the possibility of the American strike was calling United for space that would save.

Pan American reported little effect on air traffic from the TWA strike. No major recovery since been added and total diversion was estimated at less than 100 passengers by last Tuesday.

Eastern had scheduled the introduction of its Electra turboprops for today. The airline was scheduled to fly between New York and Miami, New York, Houston, San Antonio, New York, Atlanta, Tampa, Montreal, New York, Miami, and Montreal-Newark-Washington.

The airline had received six Electra's before, the grounding. A total of 12 were to have been delivered by the end of 1958, the remaining 22 during 1959.

Hector Disputes CAB Ruling Denying TWA Siesta Seat Plan

Washington—Civil Aeronautics Board denied of Trans World Airlines transcontinental Sloop Ship Service denied a seating 35-page dissent last week from Board member Louis J. Hector.

Hector criticized the action of his colleagues in denying approval to the seating plan and driving airlines the freedom to manage their own affairs "within the free play of the competitive free market."

"It is odd," Hector said in his dissent in the formal ruling in the case, "that they should have done the American Airlines, or passenger a service which is provided at no extra charge in many foreign countries and on some intercontinental routes, including almost the rear of some foreign airlines across the United States."

Negotiations for the denial, it is expected, by the other four members of the Board, were that TWA's additional service at night had been "an unmet need" and reasonably and would have done far negotiations between different classes of service since both American and United indicated the possibility of inaugurating a similar competitive service.

Opposition to the TWA service was originally filed with CAB by American. The Board, however, emphasized that its order did not prohibit TWA from offering the extra service of a plane a seating on the "heaven" service, which the Board estimated should be 20% higher than the present service, first class transcontinental fare.

Board members had originally announced their tentative vote last June after accepting recommendations favoring TWA by CAB member Richard A. White. American Airlines recently filed a dissent with the CAB for its dissent in inaugurating its formal decision (AW Nov. 10 p. 25).

Rebelling the committee's favorable recommendations of April 3, and the immediate exception filed by American and United airlines, Hector called attention to a bill filed by American on April 13.

If approved by the CAB, this bill would have permitted American to charge coach fares on Douglas DC-7's and other aircraft with seating facilities as seating "premium" first-class flights departing at off-peak hours.

"To me, who believes in the virtues of the competitive system, this seemed a very laudible development."



Viscount Displayed Behind Iron Curtain

Viscount Viscount, carrying Czechoslovak Airlines, landed last week made time and flight delays for about 210 Polish government and other officials of Warsaw Airport, conferring further TWA interest that a western manufacturer would attract an air presentation behind the Iron Curtain (AW Sept. 1 p. 47). Viscount 102, one of 11 being built for Czechoslovak, took a number of LOF Polish Airline officials on a demonstration flight. Viscount-Austrian's role effect is in cooperation with Russia which has been campaigning to get its technology and transport into across outside the USSR.

Hector and "Two large centers competing vigorously for an important segment of traffic were each giving the arbitrator more of his money in an effort to gain a larger share of the market." At present the two are that producers of consumer goods and services — both central and luxury — have throughout our consumer history done a better and better job for the American consumer under the spin of competition.

This accused a healthy development also is one of the fact that one of the crucial problems for the airlines in the end decide to increase traffic substantially and that this can probably be accomplished only by lower fares and improved service.

"Aggressively highlighted that genuine competition might look out," Hector continued, a majority of the Board thus suggested the American built before it could go into orbit and shortly after announced by press release their disapproval of the TWA Sector Steps Best.

Hector also observed that Three World Airlines had withdrawn its TWA Sector Steps Best and that it was using its competitor's speed advantage with DC-7 aircraft.

Eastern Asks Tighter Florida Competition

Washington—Eastern Airlines, continuing its fight against the Pan American National Airlines anti-competition and equipment lease proposal (AW Sept. 22, p. 38) has asked Civil Aviation Board to investigate the possibility of eliminating Northeast Airlines as a third competitor in the New York-Florida market.

Contending that the areas of its interest are directly intersected with the Board's present investigation of the anti-competition proposal, Eastern also requested CAB to consider both proposals in a hearing and discuss on grounds that National's desire to cancel out its agreement with Pan American is illegal, based upon the extreme impact of Northeast as a third carrier in the market.

Reminding Northeast's release in the New York-Florida Case more than two years ago, Eastern attorneys allege that G. T. Baker, president of National, had said that should the CAB reject the route to Northeast, National would then "sell out" to Pan American, would withdraw National and Eastern could operate successfully between New York and Miami with third carrier competition. Baker could not be located last week to reply to the Eastern statement. In other National officials declined to comment.

Three-carrier competition in the

Northeast Subsidy

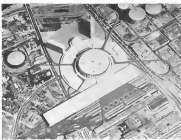
Washington—Civil Aeronautics Board last week voted to award \$4 million in subsidy payments to Northeast Airlines as reported by the carrier on Sept. 15 (AW Sept. 22, p. 38).

Announcing its decision in a closed-door case, the Board said the award was necessary to keep the carrier's route established "in view of the carrier's request and for additional working cost" and the responsibility of maintaining a dual line in time to meet Northeast's need. Application of the subsidy payments will apply solely to Northeast's route between New York and New York-Florida route, on which it began service approximately one year ago, and will mean the period from Dec. 3, 1957, to Dec. 31, 1958. Board members added that they expect to establish a dual line for the carrier by Jan. 1.

Northeast spokesman also declared to comment on the Eastern request. Delta Airlines, meanwhile, has suggested to CAB that, if Northeast is eliminated from the Florida market, some other carrier "such as Delta" should be awarded the wanted New York-Florida authority.

"Although Northeast travel market in the country" has produced only economic disaster, Eastern said, pointing to a Northeast report for \$4 million in subsidy, Delta, both in part, point that the CAB had turned its decision. The airline faction explained that the Board would the authority to Northeast case in the belief that it would "draw out the carrier's (other) recent subsidy need of \$4.5 million annually."

As a result of the anti-competition the Eastern attorney said last letter on the New York Miami route for both.



PROPOSED airport center for downtown Los Angeles, Calif., features doublet doublet terminal building with help on the roof. Long building is foreseen as a shop station for a rapid transit line. Another building (top) had also been foreseen. Design was prepared by Robert C. Wilson & Associates, architects. Two lines a corporation developed by Kenneth S. Kline, member of the Los Angeles County Board of Supervisors. Total cost is expected to be about \$28 million.

Los Angeles National has experienced a considerable delay, with Eastern's position in the market becoming "frustrated and disappointing."

Confused arguments of Northeast on the route simply postpone the issue of National, of Eastern and the taxpayer," Eastern attorneys told the Board.

"There is an action on law or on policy or equity, why the agency should not be prolonged," they added.

Northeast spokesman also declared to comment on the Eastern request. Delta Airlines, meanwhile, has suggested to CAB that, if Northeast is eliminated from the Florida market, some other carrier "such as Delta" should be awarded the wanted New York-Florida authority.

Financing Holds Up Los Angeles Terminal

Los Angeles—Plans for a proposed private airport terminal here are being postponed because of unspecified financial problems. From the present financial crisis, work has been pushed to meet the goal set by the Board of Airport Commissioners for completion of the airport by Dec. 1, 1960 (AW Dec. 2, 1957, p. 40).

Presidential veto of the Federal Airport Act is one factor behind present money problems. Los Angeles Department of Airports had expected to

receive approximately \$9 million in matching funds for the planned airport development program. If the bill is passed during the next congressional session, it is expected that funds will be returned on a grant-in-aid basis, assuming that funds will be available for recovery and interest only.

Under a proposition in the 1958 airport bond issue, airport income is to be used for the capital expenditures until 1970. Therefore, all airport capital expenditures for the next 12 years must be taken from the bond issue. This presents another financial drain, since means for bonds are not shared in the bond issue should be provided for airport expansion prior to that date.

Money already expended on completed projects totaled \$110,110. Work in progress will cost \$4,311,357, and work which may have to be considered later could cost \$5,672,869, for a total of \$11,114,336.

Increased demands for airline space in the new terminal is the third drain on funds. About 40% more space than originally planned in the airline's estimate of space requirements at the time of the bond issue is now believed necessary.

These drains on funds reported the Airport Commissioners to postpone the building program to a later date, when more money is needed and what could be postponed. The following projects amounting to \$3.1 million have been postponed:

- International's complex of airline buildings
- Microfilm room
- Loading ramp
- Second floor ticketing building No. 5
- Control glass and helipad.
- Control shopping area

Projects that have progressed, and then present state, are:

- Runway 25L has been extended to 3,000 ft and can be used for jet aircraft by the Bureau.
- Reconstruction of Runway 25R is 45% complete.
- Taxiway 25L is 25% complete.
- Foundation for the air tower and observation complex and work is about 75% complete.
- High-power lines have been put as designated at the end of new island runway.

Plans for construction of the existing terminal extension through the airport are completed and in the hands of the Board of Public Works.

Los Angeles airport commissioners hope that the Airport Act will be passed by the coming session of Congress and signed by the President, although funds are expected to be reduced to between \$3 million and \$4 million during this year's request and will be on the give-to-give basis.

COCKPIT VIEWPOINT

By Capt. R. C. Robinson



'Indefinite Ceiling'

Buena, Me.—For the past half hour I have been writing to a remarkable performance. From the cockpit tower of the AFR-1 I have been watching landings and takeoffs by such aircraft as the F-104, F-105 and B-52. More recently, I have been listening to these aircraft land and take off in a GCA in the Dow system is "indefinite ceiling 100 ft, establish (usable area) to one half mile." That is a good point of view in operating most of the airport but primarily (AW Nov. 1, p. 41).

At p. 41, the Strategic Air Command's cooperation with other military units, government and civilian groups in conducting this small program to determine the adequacy of runway lights. Both military lights, USAF alone has purchased 45 landings on the runway 113 of which will be in addition below one half mile. Added to this will be the operation by the Navy, Army, Air Force, Canadian Department of Transport, various airlines and other civilian groups. Thus, the system will be down by approximately 100 ft above aircraft, cargo, transport, Navy cargo, fighter, Contraire, Navy interceptors, air transport, etc.

The system begins to get real when, about 9 p. m.—that is, the runway begins to get real. I continued in the tower until about midnight, then left with Power Officer Lt. Col. Roy Smith for a tour of the runway (due to reports of some landing conditions) and for a chat with the pilots. Throughout the entire evening, I was particularly impressed that SAC was not looking at this project. Col. Smith appeared determined to see the best light program in the world, and the pilot-on the project are just as eager to "get out and go" as I am.

Most of the light-on-aircraft have a rather tricky job problem. Due to landing weight restrictions, some can be dispatched with about 45 tons less on board. This shows one part of the runway and, if landing is not accomplished, a quick jump to the alternate in the same runway. No. 3. If all goes well, the plane can land in this alternate with a weight of 300,000 pounds.

Approaches are accomplished by use of GCA, the ILS is not yet commissioned. This, however, does not kill the whole story. In an effort to prove the runway lights, but little credit are shown in: (1) GCA means aircraft can land in the plan at over the horizon line—over 1,000 ft. by on the approach lights which point the pilot in hold in "Take over and land runway" or pull up. (2) In a switching arrangement in the tower, various configurations of runway lighting are turned on for each approach. Therefore, the pilot is definitely on his own for the last few feet of light and must land with a better comprehension happens to be in view.

From talks with several pilots in this first test group, it appears that the runway lights should not be shorter than 3,000 ft. In the tower, aircraft pilots also indicated a need for a hybrid electronic countermeasures when the runway lights are not visible or still running at an above 100 ft. at the point and additional runway lights is required. Besides, the feeling persists with this author that, although the lighter pilots are doing a wonderful job, the single seat aircraft is greatly handicapped in all-weather work when the pilot is required to see and look, but the lights at the same time. The use of some sort of electronic pilot, preferably equipped in an ILS, appears to be a very real need.

While it is still early to draw conclusions from Dow Field, the system is capable of landing aircraft in greatly reduced visibility. Undoubtedly many things will be learned at Dow this winter, and the final results could clearly the optimum runway light configuration with inevitable good. This will be a tremendous task indeed for aviation.

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FEY THE FINEST...FLY **TWA** TRANS WORLD AIRLINES

Air India May Get Beyond-Moscow Rights

By L. L. Dohy

New Delhi-Batavia air transport pact between the Soviet Union and India opens the way for carriage of traffic beyond Moscow to a third country for the first time in an commercial air agreement signed by the Russian Government.

A bilateral pact signed with other countries outside the Soviet bloc, the Russians have carefully started any new line at Fifth Freedom traffic—the right of a carrier of one country to transport passengers from a second country to a third (AW Sept 13, p. 41).

Although the Soviet-India agreement symbolized a return scheduled service by Russian Aeroflot and India's Air India International to the present opened Delhi-Alexander-Tokent Moscow route it does provide for a commercial agreement that could lead the way to an expansion of service to the two centers beyond the present state.

It is now generally known that the Russians are eager to extend their routes to the Far East from Delhi via Rangoon. At the same time, India's air would program in developing a network of 34,995 unidirectional route miles for its Air India International in conference enough that no concessions will be made to the Russians without the benefit of reciprocal rights.

The India-Soviet pact closely follows the pattern set in the agreement between Great Britain and Russia. However, the language of the former agree-

ment has been strengthened and details of the operation have been enlarged upon, indicating that the Russians are becoming more sophisticated in working out bilateral terms.

The reference to Fifth Freedom rights in the India pact, for example, suggests that the Soviets have been willing to be generous themselves the right to even through traffic on their own airline beyond the route limits now established by bilateral trade with other governments. It also suggests that Air India is not overlooking the potential traffic value to a Delhi-Moscow-London route.

Route Preferred

Air India would prefer a direct route from Delhi to London via Moscow—a route it now uses if Russian technicians to press hard for a route beyond Delhi. Until such a route materializes, however, the carrier will stress through-coordinating service to London via Aeroflot from Moscow east. Air India's current advertising campaign on emphasizing this service. The result has been a bad factor on the Delhi-Moscow route since service began on Aug. 15 that it is higher than the load factor on any other route segment operated by Air India.

Air India lost last year around 53,112 passengers as compared with 78,860 in 1955 and 56,415 the previous year. Much of the credit for the traffic growth and the expansion of service into Russia could go to the volume

load. J. B. D. Tata, who founded Air India's predecessor company in 1912, Tata has been chairman of Air India since 1945 when it was nationalized, together with its sister company, Indian Airlines Corp. Air India operates the nation's international routes, while Indian Airlines handles all domestic service. Gains made by Tata and his staff officers during the past five years have been accomplished in the face of stiff obstacles. As one of the most underdeveloped countries in the world, India is not yet attuned to the technical requirements of modern air transportation.

Signs of industrial progress in certain areas of the country, such as the Bhakra Dam—highest on the world—and the steel industry at the Dhanbad Valley, however, fail to hide the ignorance and backward that now characterize the majority of India's some 480 million people. Tata has made plans to draw from and, thus, no extension of facilities at trained labor with which to create a working force for his company.

Tata must struggle with a caste system, including the Brahmins, Kshatriyas, Vaishyas and Sudras, who still struggle the Untouchables in a polluting climate despite the fact this classification has been lifted by law. Tata would like to see the development of a new race made up of intelligent, energetic and technologically of the caste system is to create a part of India's railways.

India's first five year plan completed



Boeing Rolls Out First 707-320 Intercontinental

First Boeing 707-320 Intercontinental jet transport rolls out at Boston, Wash., facility of Boeing Airplane Co. Company and the first 707-320s will be delivered to Pan American World Airways next autumn, following Boeing and Civil Aeronautics Administration flight and certification tests at test flight airports. Intercontinental is powered by four Pratt & Whitney JT4A-3 turbojet engines. Wingspan is 142 ft. 5 in., compared with 139 ft. 10 in. on the 707-120. Aircraft can carry up to 160 passengers.

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WORLD'S LARGEST AIRLINE/WORLD'S MOST PERSONAL SERVICE

in 1946 and the current record for year plans have made important contributions to the education and careers of the country. But Air India officials insist that the drive for modernization and modernization will be a long, drawn-out process and will take a heavy toll on the operational costs of both airlines. For example, despite the relatively small volume of passenger traffic, Air India employs 4,500 people as compared with 4,000 persons employed by Delta Air Lines last year when it carried 2.7 million passengers.

Baggage is still handled without benefit of carts or belt conveyors, and the airline's ground crew crew baggage on their hands or shoulders, means that, one way for each leg in the majority of India's airports.

In the maintenance and overhaul shops, production lines are unknown. Spares, parts and tools are stored in racks by hand. Manual labor hinders the company's planning programs in technical matters.

Despite such technical drawbacks, Air India and Indian Airlines have maintained a place in their re-equipment programs that has kept them on par, in most cases, ahead of their competitors. At a time when TWA was spending DC-8s on routes served by Air India, when BOAC was using Air Canada and then Aeromarine was flying the Lockheed 149, Air India introduced the Lockheed 748 Constellation.

The company was the first to put Lockheed 1049Cs on the European route to the Far East and, as an all-India, it will be the first to fly the Boeing 707-420 series on its routes. Three of the Boeings, purchased by Birla-Banerjee Corpn., have been ordered by Air India for delivery in 1968.

There is confidence that the more modern equipment will counter the major problems operationally than he has faced in the past. Despite the shortage of skilled labor, for example, Indian Airlines completed its thirteenth period

with its fleet of Viscounts without encountering serious difficulties.

The 100-seat, 46-passenger aircraft and 30 pilots in service operating the Viscount and to Mohen-Ahmednagar in Crest before for complete towing on the airplane. The group is expected to be a 100-seat, 46-passenger aircraft and 30 pilots in service operating the Viscount and to Mohen-Ahmednagar in Crest before for complete towing on the airplane.

Tata has similar plans for introducing the Boeing 747. A Boeing simulator and test cell will be installed at Bombay and an intensive training program is now in the making in preparation for the deliveries. Most Air India officials now feel that the accelerated training program will enable the company to expand without causing any great increase in the present personnel complement. All plans and in both companies are active factors who have been trained by the airlines from former flight to commercial roles.

Air hostesses were originally trained by one TWA stewardess sent to Bombay to establish the airline's hostess school. Since then, all training of hostesses is done by the company.

Air India officials are generally satisfied with the operating arrangements with the Russians. The bilateral agreement calls for the frequency and scheduling of service on the "basis of complete equality and mutual benefit."

No optional facilities required for the operation of the service are carefully set forth in the agreement. Arrangements for the change of air traffic also included in the bilateral pact, a clause seldom found in other agreements signed by the Russians.

Provisions covering the handling of revenue in-kind, or income or fixed liabilities are virtually the same as those agreed to in the British-Soviet pact. Unlike other bilateral agreements signed by the Russians, the India agreement contains no provision as to the language which will be spoken on the aircraft by crew or flight attendants. The agreement was completed in Hindi, Russian and English languages.

Air India has bilateral rights to serve the U.S. via both Atlantic and Pacific gateways but the company has no regular plans for adding the additional route to its services despite the obvious advantages to the service. In addition to the Moscow route, Air India operates the way between Bombay and London at a major route segment of its service. Alternate stops on the route, which is served by seven weekly flights, are made at Rome, Paris, Prague, Düsseldorf, Zurich, Geneva, Gino, Bern and Dortmund.

The airline operates a fleet of 10 Lockheed 1049 Constellations, which offered a total of 50 million capacity

has added during the year ending last March 31. In addition to its European service, Air India operates to East Africa via Karachi and Aden, to Hong Kong and Tokyo and, in 1966, the first service to Sydney was implemented.

As set of the Indian Parliament in 1955, the airline was nationalized. The decision to nationalize and nationalize the two carriers was based on an inability of either company to raise capital to finance future equipment.

Both carriers place emphasis upon passenger service as the competitive strategy most likely to win in the race for traffic once high-capacity jet transport aircraft are introduced as a large scale ground passenger service has been extended by the Moscow-Uchi route and is a selling point the company will use in developing the route.

F. R. Petus, Air India's vice chairman, told *AIRWAYS* Wayne that the development of a fine service program has not been difficult. He explained,

"In India, the natural inclination to serve is a natural characteristic." This spirit of service, he said, has been extended by the Moscow-Uchi route and is a selling point the company will use in developing the route.

Northwest Nears End Of Finance Program

New York—Northwest Airlines financing for its 10 Lockheed 1049Cs and first Boeing DC-8s is now substantially complete if a financing program including bank and institutional loans and use of preferred stock can be realized.

Northwest is negotiating a 10-year \$60 million loan with institutional or senior-senior companies, pension funds in trust funds and a seven year bank loan of \$32,500,000. The convertible preferred stock, which probably will be sold next week, is expected to bring in \$11,000,000.

The \$75,500,000 total subordinated would first be used to retire Northwest's current \$34 million bank debt and the \$79,500,000 balance applied toward its equipment purchases. The bank \$67.5 million, and \$51.5 million allowed by 10 Lockheed for the purchase of four Boeing 707s. Subordinated at a unit price of about \$394,000, and \$6,750,000, the balance allowed by Douglas Aircraft Co. for DC-7s, at a unit price of about \$3.5 million. This leaves a balance of \$17,750,000 which Northwest would be required to raise from depreciation and retained earnings.

Clarkston and bank loans is dependent on Northwest raising a minimum of \$10 million in the preferred stock sale. The institutional loan will carry a 6% interest rate, the bank loan 4.5%.

11-18s for China

Moscow—Soviet aircraft manufacturer, reports that "the time is not far off" when the Soviet 11-18s Moscow (airplane) transport will begin operations in Communist China. Aircraft officials say a large group of Chinese pilots, engineers and mechanics are now in Moscow for 11-18 training. The airline added that the aircraft has been equipped since one of the Chinese modernized Russian will enough to be given 11-18 operation.

Moscow—Airline of People's Democratic China is now operating a fleet of 11-18s and 11-20s on domestic routes that serve Russia through the Alma Ata and Tashkent gateways.

Airline Income & Expenses—Third Quarter, 1958

(IN DOLLARS)

	Passenger Revenue	Fuel Revenue	Freight Revenue	Other Revenues	Federal Subsidy	Total Operating Revenue	Total Operating Expenses	Net Income Before Taxes
DOMESTIC TRUNK								
American	75,201,183	1,457,299	2,516,799	394,989		80,133,269	72,117,336	10,015,933
Boeing	12,874,879	279,878	879,399	21,879		13,835,035	12,495,499	1,339,536
Capital	34,741,440	641,520	109,477	14,370		35,506,814	34,008,756	1,498,058
Continental	7,752,414	7,751	195,009	116,746		7,955,920	7,185,144	770,776
Delta	10,328,874	438,481	1,207,382	223,211		12,037,938	10,456,459	1,581,479
Eastern	10,263,170	239,993	413,854	38,147		10,955,164	9,765,114	1,190,050
Midwest	4,880,170	74,212	316,834	2,537		5,273,453	4,768,419	505,034
Norfolk	1,757,530	48,424	334,331	27,119		2,167,404	1,958,979	208,425
Northwest	32,123,250	1,044,288	2,471,713	118,099		35,757,350	32,275,458	3,481,892
United	77,871,291	2,386,102	3,709,204	718,482		84,685,079	76,884,264	7,800,815
Western	11,173,204	211,156	444,454	45,441		11,874,255	10,346,245	1,528,010
INTERNATIONAL								
American	1,441,218	8,419	195,284			1,735,229	1,717,297	18,932
Boeing	1,371,124	33,201	318,299			1,702,724	1,670,188	32,536
Continental	837,840	3,919	16,733	7,732		866,224	866,740	-516
Delta	1,246,154	34,472	31,308	3,848		1,315,782	1,272,211	43,571
Eastern	4,170,277	100,440	319,211	143,849		4,633,777	4,326,410	307,367
Midwest	134,411		1,874	30,419		136,294	136,159	135
Norfolk	1,198,257	10,142	42,000			1,250,400	1,275,411	-25,011
Northwest	4,181,830	1,653,288	910,233	209,793		6,955,144	6,547,889	4,065,255
United	750,488	39,150	117,425	38,334		1,105,403	1,077,247	28,156
Western	29,266,497	1,073,142	3,709,361	1,163,849		34,149,750	30,805,867	3,343,883
Boeing	1,246,490	582,107	9,677,840	477,119		12,513,556	12,019,469	494,087
Continental	14,297,479	1,293,793	2,444,211	1,778,212		19,813,695	17,720,733	2,092,962
Delta	3,818,138	104,823	434,284	30,884		4,367,129	4,159,497	207,632
Eastern			1,697,450			1,697,450	1,439,448	258,002
Midwest	26,796,792	1,034,320	1,388,223	1,227,870		29,446,135	28,267,289	1,178,846
Norfolk	1,198,257		1,874	30,419		1,230,550	1,230,550	
Northwest	4,673,140	1,407,889	91,284			6,172,313	5,381,197	791,116
United	564,816	1,414	4,201	9,270		5,789,296	5,611,901	177,395
LOCAL SERVICE								
Airway	1,478,794	30,778	84,341	3,201	1,471,044	2,079,128	2,053,303	25,825
Boeing	447,908	5,188	31,957	8,361	503,414	5,476,416	5,488,995	-15,581
Continental								
Delta	947,378	26,488	102,648	11,790	778,316	1,052,597	1,052,597	
Eastern	309,530	12,448	34,441	3,067	460,026	106,199	101,441	45,755
Midwest	1,428,281	21,124	48,298	77,919	1,575,622	2,392,327	2,392,327	
Norfolk	2,473,820	68,450	177,047	1,338,001	4,049,318	4,686,478	4,618,468	68,010
Northwest	1,512,441	65,129	74,463	19,741	1,671,774	3,104,191	2,999,490	104,701
United								
Western	1,416,440	26,008	34,240	15,432	1,492,120	2,340,144	2,340,144	
Boeing	471,137	17,916	48,710	1,840	530,603	1,434,428	1,434,428	
Continental	712,388	39,870	34,384	1,543	788,185	1,970,655	1,970,655	
Delta	707,911	12,118	31,117	8,709	759,855	1,238,150	1,238,150	
MAIL SERVICE								
American	1,827,371	11,201	197,728	816,497		2,942,397	2,782,399	159,998
Boeing	751,411	1,211	34,143	24,317	7,721	774,584	615,394	159,190
CARPO LINE								
AACCO*								
American	10,390	2,093,373	4,901,249			5,014,710	5,115,884	1,093,150
Delta	10,390	1,184,444	944,437			2,184,402	2,077,891	1,066,511
United			1,813,247			1,813,247	1,599,899	213,348
WHEELSPIN LINES								
Chicago	10,312	7,754	1,000	2,802	135,201	150,879	149,184	1,695
Los Angeles	15,284	30,120	24,284	611	137,211	208,284	202,289	5,995
New York	16,574	13,664	11,754	19,514	549,901	386,919	386,919	
ALASKAN LINES								
Boeing	477,333	149,130	149,769	599,414	412,437	1,779,053	1,766,393	12,660
Delta	381,444	20,220	32,140	12,838	74,120	420,762	420,761	1
Continental	45,419	16,451	17,201	16,721	75,231	146,124	146,124	
Delta	970,229	19,220	23,793	34,730	103,947	1,128,719	1,128,719	
United	381,444	16,451	17,201	16,721	75,231	1,128,719	1,128,719	
Boeing	2,395,120	17,411	37,498	17,411	393,444	2,553,144	2,475,371	77,773
Western	416,444	129,329	184,109	335,951	174,438	1,360,269	1,360,269	

* Not available.
 *Compiled by AVIATION WEEK from airline reports & the Civil Aeronautics Board

SHORTLINES

Allegany Airlines reports October air traffic and is expected to board to total 51,000 net miles, a 12% increase over the previous second month of September. For the first year, Allegany has served 150,000 net miles of air cargo for a 17% increase over the same period of 1957.

At Fresno, under an agreement between the French and Canadian governments, has added its regular passenger service between Chicago and Montreal and return. The agreement permits Air France to serve passengers between the two cities, whereas the center formerly could only carry passengers to the terminal cities of Chicago and Paris.

British Overseas Airways Corp. advance reservation for its Montreal-Paris-Dublin route is set for December-January as 95% above advance bookings for similar period earlier service last year. The Coast 4 "Masters" service, formerly operated by Boeing Stearman, carries 12 passengers in normal day and includes configuration. BOAC's winter schedule from Montreal and New York to Seattle will be 24% increase in seats available, to 100 seats per week, using both Douglas DC-7C and Bristol Britannia aircraft.

Northwest Airlines plans to begin service on its new Chicago-Fargo route today on an initial schedule of eight daily flights between Chicago and Fargo. The flights will be Monday and Tuesday. Northwest's Chicago-Fargo route will be the first of a series of new routes to be added to the airline's system. The new routes will be added to the airline's system. The new routes will be added to the airline's system.

Pro American World Airways plan to initiate daily Douglas DC-7C service today on its New York-Nassau route. Southwestern Airlines will have New York-International Airport at 10:30 a.m. arriving Nassau at 2:30 p.m. North American Airlines will have Nassau at 4:00 p.m., arriving New York at 7:30 p.m.

Roble Airlines has resumed scheduled cargo service to and from Philadelphia from its Florida base. The cargo aircraft, which last March received CAB authorization to resume Florida plus operations for new cargo, now is a new freighter to service those weekly operations.

AIRLINE OBSERVER

With far new action in the application by American Airlines S. A. for a change in current present Peru and Mexico. For objective in Peru American Airlines which had filed for insolvency as a result of heavy losses American companies in tropical by AFSA (see AW Oct. 13, p. 31). Peruans contend that AFSA is not controlled by Peruvian interests as required by bilateral agreements but is dominated by its interlocking pattern, Transamerica, American National of Honduras. Peruan charges that both Latin American carriers have refused to comply with a Civil Aeronautics Board subpoena directed to them to submit any evidence on control of AFSA and have also refused to allow any additional information requested by Transamerica. Peruan has asked that the CAB reverse an earlier ruling granting AFSA's overseas operations on the basis and has also filed suit in U. S. District Court in an effort to force compliance with the CAB subpoena order.

Norway Air Transport Service will take over certain scheduled flights formerly flown by Trans World Airlines. MATS will fly the flights, an interim measure during the strike of International Air of Netherlands against the airline, as necessary to handle the flow of armed forces passengers and cargo traffic. The MATS flights, conducted by "meet the immediate requirements of the Department of Defense," will continue until the strike is settled in an adequate substitute service is negotiated.

Discontinuation of U. S. bilateral air agreement by France may result in withdrawal of certain operating rights if the agreement is allowed to expire on Nov. 15. In such an event, both the U. S. and France would have to lose certain routes and reconfiguring airplanes under the action on the part of one country would possibly require action on the part of the other. For example, if France were to deny U. S. carriers the right to fly beyond Paris, the U. S. could demand Air France's consent to prevent the carrier from adding routes within the U. S. to serve beyond Paris. Since a large portion of Air France traffic to the east is provided in the U. S., losses to all carriers involved would be substantial.

Sid Aviation's triple-engine transport helicopter development (AW Nov. 24, p. 35) is among the future equipment possibilities under consideration by New York Airways. The French aircraft is designed to carry 1200. Capacity will be between 20-25 passengers, cruising speed around 125 mph. Design is said to offer one-engine-out performance and all-weather capability.

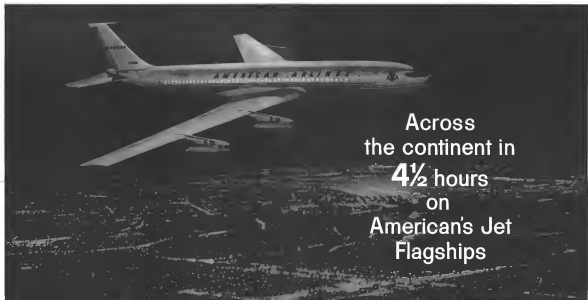
An aerial traffic control center to be constructed at Pomona, Calif., as a replacement for the present facility at Oakland Airport will be leased to the Civil Aeronautics Administration for 10 years by J. H. Pomona & Co. and McClellan Co. Government holds an option to purchase the facility at the end of the rental period. Construction bids have been offered for the aerial traffic control center and under construction by the Government Service Administration for the CAA.

Clark Air Lines has resumed Pilot Employment Associates to handle preliminary screening and selection of 36 new pilots. The contract was renewed its present rate of \$154 pilots to serve new routes tentatively awarded the airline in the Service Status Area Code.

Confirmation will be continued by all but three scheduled airlines at Los Angeles Traffic Conference meeting in Houston, American, Midwest and Frontier decided to drop the recommendation plan as an authority, means of meeting airlines. Results of the meeting will be applied to application on all others as to route suspension during overnight or longer. Minnesota has been on budget flights will be dominated by all routes after Dec. 1.

Salem Region Airlines is shopping for new turbine helicopter equipment. Interest in being shown in the Sikorsky H-43 but Vertol H-43 also has been studied.

Northwest Airlines has received Civil Aeronautics Board approval to lease two DC-7C from Cavanaugh Inc. at a rental rate of \$18,000 per month per month for use on the current newly awarded route between Chicago and Florida.



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Explorer Data Analysis May Take Years

By Evert Clark

New York—New details in the Army's Explorer satellite program recently said they will attempt to orbit a 190-lb. satellite sphere in its first steps—described by G. Rohlfeld of California Institute of Technology's Jet Propulsion Laboratory at the American Rocket Society's annual meeting here.

Explorer's Jupiter C vehicle has had one launch and satellite firing so far, with no recorded success. It has put three satellites into orbit.

Rohlfeld said the vehicle, "however complicated it was, never as complicated with Vanguard and however it operates it was to be as simple as possible, has been to date completely successful in accomplishing its objectives: the exploration of space and the acquisition of fundamental knowledge of our planet's environment in the universe."

Army Ballistic Missile Agency handled development, construction and operation of the first-stage booster rocket and guidance system for the Jupiter C. JPL developed the three stage upper stages. Air Force Cambridge Research Center, the State University of Iowa and other groups contributed heavily to the Explorer program itself. First Jupiter C firing, in September of 1958 was a test of the vehicle itself. Second and third shots tested a model of the Jupiter next core under zero gravity conditions.

Modifications to the Redstone first stage included delaying the propellant tanks to increase burning time to 155 sec and use of liquid-fuel instead of solid to increase thrust from 75,000 to 81,000 lb. No major modification to the engine was required.

Three upper stages made up of 6-in. diameter side sections of 10-in. diameter of the Sergeant missile capsule, are combined in a "hub" which is spun by two battery-powered motors mounted in the instrument compartment. Also in this compartment, which is located between the dual-stage tanks and the hub, are guidance and control equipment and spatial attitude control for aligning the upper stages horizontally before second stage is ignited.

Second stage is a ring of 11 solid Segments, chosen because they had extremely high performance and had adequate coast time 300 sec. tests showed this ring in the third stage, consisting of three subnets, topped by a conical structure that contains trans-

mission and batteries for firing the third and fourth stages. Structure also supports the fourth stage. Nozzle exit diameter in the fourth is somewhat smaller than on the other sections, to allow launching clearance. The motor is attached directly to the instrument package and becomes a part of the satellite itself.

An improved payload was ready for use in the fourth stage of Explorer I for the first Explorer IV and V were scheduled to be fired, this improved payload was qualified by extensive static spin-testing for use in the third stage, and a still better payload was put into the fourth stage.

These payload changes plus design refinements of fittings altered for stresses in payload of about 3 lb.

Firing sequence is as follows:

- This is now to 900 rpm (revs) to take-off. At about 1000 plus 70 sec, a gyroscope controlled by a preprogrammed rotation rotation gradually until it reaches 750 rpm about 10 sec before first stage is burned.

- Then chronometer measures between spin frequency and loading frequency of the motor.

- Motor is tilted so that trajectory is inclined approximately 40 deg. in the direction of first-stage burnout by a 40-deg. pitch rate.

- Five seconds after burnout a time antenna on explosive bolts, separating the tank section and the first stage from the guidance compartment—plus upper stage hub. Failure of Explorer V was attributed to poor separation that allowed the booster to accelerate and turn the guidance tankling the gun.

- Vehicle spins to spin about 800 rpm. In this time, the spin rate of the hub section, upper stage, are each parallel to the local horizon. The two guidance gyro for reference and small compensated as main placed in the hub of guidance in control.

- Time of spin is determined by a radar tracking unit which predicts spin time on accelerometer in the attitude which align by telescope the heading of vehicle in first stage, and Doppler tracking. All are fed into a small computer that averages the estimate, allowing for superior quality of the three types of data. itself is used to set a timing device which sends a radio command signal to the motor to fire second stage.

- High speed stages have for about 10 sec. Two seconds coasting time is allowed between stages to ensure thrust decay. Pressure rise in the second-stage motor starts a timer based in the ground support for the fourth stage. Eight

seconds later at five the third stage, and eight seconds after that, the fourth stage. Stages have burned out after stage behind its burning stage pass.

Failure of Explorer II was traced to a structural failure in the upper support for the fourth stage. This light plastic cone apparently failed under spin, motor and vibration loads but it was strengthened in subsequent vehicles.

Data collected thus far by Explorer is so extensive that it may be several years before it is completely analyzed, Rohlfeld said. The information they can estimate includes:

- Explorer I. Micrometeorite densities from 30 particles/m³ to 100 particles/m³ in the lower atmosphere and three particles/m³ in the upper atmosphere. About 100 particles in diameter, confirming previous estimates and showing the existence of problems in spaceflight designs. Internal temperature ranged on from 45 to 104° F. Cosmic radiation, however, was estimated to be at least 1,000 times greater than expected.

- Explorer III. Orbit decayed to a 107.2 mi. perigee and 690.2 mi. apogee in two orbits before satellite data on June 19 and decay reached orbital data on atmospheric density. Dawn rate was 0.3 mi. per day. On the other hand and April 11. It was 11.95 mi. between April 11 and 15, and 14.99 mi. between April 15 and May 11, and 14.46 mi. between May 11 and June 10, and 16.9 mi. between June 10 and July 10.

- Explorer IV. Preliminary analysis shows that the number of cosmic ray particles going through the unshielded Geiger tube from all directions was in the order of 60,000 per sec. At least 50% of them have enough energy to penetrate the lead shield around the other Geiger tube, Rohlfeld said. There is an even greater density of low energy particles. They are about 1,400 per sec. about one million per sec. from all directions. Since density measurements change as the satellite rotates around as axis, it appears that more than 10% of the particles come from "one to two directions," he said. First two weeks' data indicated an increasing intensity with altitude, at all latitudes.

Radiation varied both in quantity and quality with both latitude and altitude—densities in excess of 100 neutrons per hour have shown.

Explorer VI, carrying a 12-in. diameter plastic sphere designed by National Aeronautics and Space Administration, was launched in October but upper stages apparently did not fire.



Army Ballistic Missile Agency prepares for the Explorer VI in a Jupiter C satellite vehicle from Redstone pad at Air Force Missile Test Center, Cape Canaveral, Fla. Vehicle carried an International Geophysical Year satellite designed by National Aeronautics and Space Administration, but malfunction in upper stage motors prevented successful placing of the 9.25 ft., 37 ft.-dia. satellite sphere.



Final stage is checked (above) before launching (right). Also shown coil and more than plastic film satellite is given a "check-in-the-sphere" by an extra rocket that points downward at launch but is oriented toward rear of satellite in its random position half-way around earth from launching site. Filled sphere is to be spun and inflated by a cartridge. Atmospheric density and guidance assemblies shelter an altimeter.



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New York—Space and reentry test vehicles that would use proven solid rockets and rest only one fourth as much as the liquid-fueled reusable boosters now being used for such work, has been proposed to the military services and the civilian space agency by Boeing Aerospace Co.'s Systems Management Office.

Vehicles also would prevent off-the-shelf items—JATO bottles with thousands of fragments behind them. Control on other ejector could be maintained with as few as two of the eases, which means that the vehicle would have "multiple-ejector reliability." Voices are simpler by the reaction of

By Edmund J. Kinnear. Reviews the history of lighter-than-air balloons and proposes important new military and commercial uses for the now straggled zepplins. "A fascinating look . . . [at] prospects of modern air power will be started with the thought-provoking summary." —*The Air Resource* 23 photos. 25 pages. \$3.95.

By Winifred von Braun. "As soberly and methodically as an airline operations manual figuring the balance of fuel and payload between Chicago and Los Angeles, De von Braun in this brief book lays out down what we will need in order to fly to Mars"—*AMERICAN JOURNAL*, 96 pages, \$1.95.

Edited by John F. Murberger. "A primer of space flight that will enable many people to realize that outerplanetary travel is no longer in the realm of fantasy"—*Journal of the American Medical Association*, 18 Apr 83 pages. Paperbound, \$1.90, clothbound, \$3.00.

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Space Probe Recorder

Miniature magnetic recorder, developed by Lockheed Aircraft Corp., Menlo Park, California, can store three million bits of information yet it weighs only 5 lb., measures only 9 x 5 x 4 1/2 in. Device, which measures 400 ft. magnetic tape at tape and records two channels of information simultaneously, can record 96 min. of unattended test recording. Data can be read out at or near recording speed. Recorder is fully transistorized and consumes only 30 watts power. Lockheed has built four prototypes.

test surfaces used as Boeing's Boeing instrument engine.

Addition of an upper stage, such as Allegory Ballistic Laboratory's Meteor engine, developed for the Navy's Vanguard missile vehicle and used in USAP's Thor Able-center and Titan probe vehicles, would create a vehicle capable of putting 100-400 lb. in orbit, project engineers said.

Propellant Reliability

Boeing's investigation of solid and liquid propellant reliability, based on failure analysis made and their failure and success, indicated a reliability is no for solid propellants of about 100 to one.

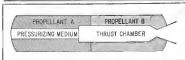
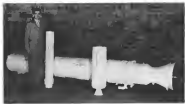
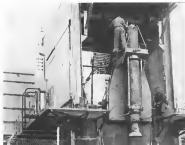
These figures took into account all sizes and types of both kinds of rockets, made by a variety of manufacturers.

Cost studies indicate that Star could be produced for one-fifth the cost of the Jupiter and Thor intermediate range missile boosters being used at some to be used in both missile and space probe work. Major reason for the difference is one in that Star's components are fully developed and are casting stress. Both Jupiter and Thor still are considered to be in the research and development phase, although both have made a number of successful flights.

Preliminary Discussions

Preliminary discussions have been held with National Aeronautics and Space Administration, several Air Force offices, and the Advanced Research Projects Agency.

Boeing is stressing low cost, high reliability, quick availability and versatility in its discussion of the proposed vehicle-response design in view of increasing competition for space funds as more projects are approved.



New Rocket Family to 50,000 Lb. Thrust

First photo shows Rocket Motor Inc.'s new family of liquid propellant engines currently being developed designs that can be used to meet virtually any requirements. The company reports: Large unit, using horizontally as ground as before, photo and on test stand in top photo, is 19 ft long, 10,000 lb. thrust motor, first level several weeks ago; on left is Guidance II currently in production and expected to start flight tests as a Navy missile before the end of this year; on right is Guidance II, under development by Navy, which has entered a launch motor. Guidance I and II are both slated for tested under one track of new family is designed to concept of providing complete powerplant system, from propellant to thrust chamber, can be factory tested and stored for several years. Units can also be used as the actual motor body, adding vertical and fin to complete the weapon. Large motor has completely external thrust chamber. Guidance I has completely enclosed chamber and Guidance II has partially enclosed unit. Placement of chamber depends upon dimensional and structural quality requirements.

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MOUSE compartment to be placed in Ther-Wife over cage is at left, mouse is breathing oxygen and cool. Mouse exerts and egs wt. behind mouse, carbon dioxide chamber is attached to grille. Space Technology Laboratories' Ardenchades Laboratory directed mouse respiration. Field (third mouse) covered 6,800 sq. ft. at speed reaching 15,000 mph.

Mice Survive Thor-Able Re-Entry

New York—A small white mouse named Esita was fed some 2,600 calories a day in a test whose cause and apparently involved 45 men of weightlessness and all other stresses involved in re-entry from space. 1,400 calories a day including more than 60% carbohydrates.

Major use was of three fixed in General Electric Co. vibration type, one runs on Thor-Able launching vehicles last April and July. Increases of the next was done on a two-unit system.

tion as a numerous biological experiment. First mouse was not captured, and none was recovered, but telemetry indicated the second and third mice lived throughout the flight.

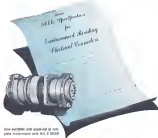
Known as Project MIA (Monarch-Able), and conducted by Mrs. Evelyn L. van der Wal and W. D. Young of Space Technology Laboratories, the experiments were described in detail at the National American Rocket Society meeting here.

Although no generalised conclusions



MOORE'S identity equipment is checked at Space Technology Laboratories. Low-boiling organic vapor, upper cylinders contain, in purifying chemicals, water and a Meyer system. Cables suspending lower cylinders contain telemetry connections. Unit will be placed in Thor-Able nose cone to estimate recovery after re-entry.

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Write for more complete information on this latest addition to the ever-growing family of Borden electrical components.

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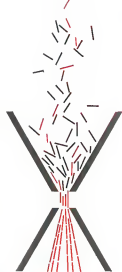


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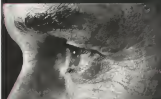
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WARNER (above) was designed by Space Technology Laboratories to prevent mouse from interfering with telemetry equipment during flight. Sewed back on back were wire sockets in mouse's chest. Below, telemetry wires are attached surgically to mouse. Mouse's reactions to space flight, including weightlessness, were monitored during flight in Thor-Able zero zone.



can be down faces the three flights on the Wal and Young made these observations:

- **Acclimation** both were provided by Laska's heart rate, but not by the heart rate of the third mouse, named Bony.
- **Slave both Laska and Bony** flew to 3,400 m altitude and the Russian dog Laska, studied up to 1,600 m altitude at its weight, the most sustained to climb from a greater altitude than that reached by any other living organism.
- **Decompression** in Laska's heart rate at first stage barometer was gradual, but at second stage barometer it was sharp. This was in response to the first rate behavior of Laska. No trend was detectable in Bony's heart rate of first-stage barometer, but a definite increase was apparent at the beginning of weightlessness.
- **Noise** (unmonitored mouse) gave evidence of distress due to weightlessness.

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ROKUS aluminum and magnesium casings (left) tracked by Douglas from fabrication in New York, New Jersey and Pennsylvania, are checked for fit with Kroy cut. After long diameter cut, machined on vertical lathe, casings are drilled and tapped (right).



Douglas Tailors Plant for Nike Hercules

By Michael Yaffee

Charlotte, N. C.—Productivity for fit at the Army's Nike Hercules surface-to-air missile has resulted in a Douglas Aircraft Co. plant designed exclusively for missile production and believed to be the largest effort of its kind in the United States.

Douglas engineers claim that because of plant design and the missile's particularities, the Charlotte Division produces the missile at less cost than any other in Douglas. The reasons:

- Extensive design has no compromise in engineering equipment set floor plans on established production.
- High rate of production.
- Tooling made especially for missile production.
- Lessons learned in the manufacture of nuclear vehicles.

Before Douglas opened into the Army's Charlotte Ordnance Missile Plant, the company held a number of conferences with the Army and with a president of Western Electric Co., the prime contractor for the Nike launch of missiles. It was then decided that the plant was to be rehabilitated and what new construction was needed. On Dec. 20, 1954, Douglas signed a contract with the Philadelphia Ordnance District for design and operation of the Charlotte plant.

Thus, where once plants simply fit missile production into existing facilities and often spent it weeks around existing production lines, the Charlotte plant was designed solely for integrated missile production.

Douglas, accustomed to meeting face prices in engineering, was able to come out extremely cost studies to find

the most efficient way of producing missiles.

At the same time the 15 Douglas employees who were transferred from Santa Monica, Calif., to form the nucleus of the new operation brought with them considerable production experience gained from work on Sparrow I, Honest John and Nike Ajax.

The design of the Ajax, of course, had been set and there was little that could be done to alter its production. It wasn't until the Hercules went into production that the Charlotte plant was able to come into its own.

Missile booster, the Nike Hercules is 77 ft. long. Body diameter is 12 in. Missile skin is aluminum throughout and center fins also are aluminum, while elevators and forward fins are magnesium.

The skeleton of the rocket con-



HERCULES engine began to take shape when machined and painted casings are placed on assembly fixture (left). After skin parts are cut out, workers enter main engine section to shoot elastic webbed into casing (right).



MISSILE ENGINEERING



BORE-PLASTIC (left) sections being bored to size. After inspection checks casings with production inspection gage (right), they get elastic treatment and then are covered with new chamber primer.



sists of a series of narrow cylinders and a small number of longitudinal stiffeners which serve as the load-carrying members of the vehicle. The stiffeners are cut from either aluminum or magnesium to save weight and the face and cut of extensive machining. Stiffeners are extruded from the same materials for the same reason.

Aerodynamic heating and stress determine the choice of coating material at most specific points in the surface that generally, selection of cylinders is based on a cost-weight basis. As a result, most of the casings in the Nike Hercules engine are aluminum.

Artisans actually began to take shape when the longitudinal stiffeners are placed to a series of spaced cylinders using a horizontal automatic lathe. Six punches are mated to the cylinders and stiffeners. External perforations or holes shrouded flange to give an aerodynamically smooth skin. Points and corners are welded with elastic material to keep them hot and hot.

Two of the three main body sections are bolted together at the plant. The third, which contains the warhead, is mated at the missile launching site for purposes of safety. The same section, the solid propellant chamber, which is fastened to the casing in the first two body sections is not mated until the Hercules is in the field.

Tapezoidal Sheet

The tapezoidal aluminum sheet, which is used for the main case, is first roughly shaped on a long, multi-roller mill which draws into a rough shape. There are three sheets of sheet steel across the trough in the roll large drawing, forcing the sheet to curve upward. When half the sheet is curved, it is squared and turned around. The half that is still flat is then fed across the trough and curved to meet its opposite edge.

The half, one of about a mass welded into a rough shape over. This is dropped into a large tank of a large bath

de which is sunk to floor level. The inside half of the case is covered, the cover sealed and the case is blown out to the required dimensions at 600 psi.

Welding is kept to a minimum in the construction of the Nike Hercules. Initial cost studies indicated that over 90% was possible in terms of non-ferrous welding, particularly at Charlotte where Douglas was starting from scratch. Welding affects the strength of a part, for example, and valuable time has been seen as to be lost just straightening, welded areas out.

The choice of cylinders in the main material, load-carrying elements was another matter. The alternative was to start with aluminum or steel bar stock. While the bar stock would provide the strength needed for internal load carrying members, it would also have to undergo extensive machining to give over the excess weight. Use of bar stock, it was decided, might be justified in missiles that were to be



FIGURES engine sections (left) are limited into welded material for final assembly. An engine moves along hump-shaped casing, workers install internal components and erect cable bracing for the guidance and control pod (right).





FITTING THE MACHINE TO THE MAN

*A New Idea in
Helicopter Piloting*

This steel giant, world's most advanced dynamic flight simulator, is nearing completion at Bell Helicopter Corporation. It is one of the most important tools in the Army-Navy Instrument Program, of which Bell is the rotary-wing industry coordinator. Goal of this long-range program is to provide (ideal) all-weather cockpit instrumentation, needed for the helicopter's own special needs. In short, to put an actual picture of the outside world right in the cab's... making helicopter piloting almost as simple as turning on the family television set!

Philosophy behind Bell's extensive research and development embraces an entirely new concept. Historically, both fixed wing and helicopter cockpits have been designed around the instruments. Now Bell seeks to fit the machine to the man. Improved displays and controls will release the pilot of today's instrumentation complexities... allow him to perform only those functions which he does best.

Successful completion of ANIP program will have far-reaching benefits... for the helicopter, the aircraft and for every branch of military service. Its principle can be adapted to every man-made machine... missiles, ships, submarines, tanks... perhaps even tomorrow's automobile. Selection of Bell as industry coordinator for this all important program is indicative of Bell's stature and reflects the pioneering spirit that has made Bell the greatest name in helicopters.

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MAIN engine casing and nose cone of Nike Hercules get back seat of seats as they move through entrance point and then set up in final assembly building.



STAGED for trip to inside lift, nose cone is reversed and inserted into main body casing which then goes into speed-shaping machine.

produced in very small quantities.

But for a large scale operation such as the Hercules, studies definitely indicated the use of casting, Douglas states. They are comparatively inexpensive to produce, in large quantities, light in weight, and require a minimum of machining.

And with the development of special tooling, much of which Douglas carried itself to a well equipped machine shop at the Chrysler plant.

Castings permit rapid waste production in one operation, for example the cast cylinder is ground flat and down, a cylinder speeds is lowered and internally drilled using holes through the cylinder wall in a 90-deg pattern.

The use of special tooling, as then, is made economically feasible by the high rate of production in the Hercules operation. Design and manufacture of the Hercules, for example, is similar in many ways to that of conventional aircraft, but the comparatively low production rate of the latter makes tooling operations more attractive. In a

case where an aircraft part required a number of similar holes, for instance, they would likely be drilled in sequence by hand rather than by a machine with a conventional link pattern.

Missile Experience

Veterans in the aerospace business and with missile experience dating from 1945, Douglas was able to bring much valuable knowledge to bear on the Nike Hercules operation. But the experience must directly applicable to the production of the Nike Hercules derived chiefly from Douglas' work on the Hawk Jets and on the Nike Hercules, according to Donald Justus, chief engineer at Chrysler Division. Elmer Jaka approaches Hercules most closely in size, type, an external structure.

An important overview from the Ajax program came by Justus, for example, is the overhead conveyor line used in the final assembly of the Hercules. In its early work, Douglas used rollers extensively to move missile sections.

The switch to an overhead conveyor enabled the company to get rid of some of the rollers and under the floor. Even more beneficial, it moved the exhaust section in even level, permitting workers to install equipment and run the required test tubes, from inside and with less physical strain.

At the same time the differences between the Hercules and other missiles are significant in the difficulties. The construction of the Ajax exhaust, for example, differs noticeably from that of the Hercules. The smaller Ajax hole is made up to a large degree of long tubular castings bolted together. These castings, which are always bolted, machined, from both the load carrying structure and the external sealant. Cost and weight of such a structure, Justus claims, would be prohibitive for the larger Hercules missile.

Soviet Union Reports ICBMs in Production

Moscow—The Soviet Union's intercontinental ballistic missile has reached production status, it is claimed here. A report that the USSR is now producing ICBMs was based on a single sentence of an 18-page outline of Kozlov's new aerospace plan. "Production of intercontinental ballistic missiles has been successfully set about," it said.

The plan carried on further after it is to be made of any type although it did state in the same paragraph that "improvements are being made for test to external bodies."

Since the Soviet announcement last August of an ICBM launch, Premier Khrushchev, in several tests conducted in its production but that is the first definite claim to such status.

Also included in the aerospace plan is a forecast that as travel will increase exponentially visible in the Soviet Union during the coming years many it means the introduction of large turbojet and turbo-prop aircraft will be responsible for making an important one at more categories of passenger transport in the USSR. It has been these modern aircraft, more than 30 airports are being built or modernized, the report said.

The network of feeder lines will receive particular attention during the seven year period between 1970 and 1985, the outline of the plan indicated.

In fields allied to aviation, the plan called for ship boosts in the output of the plastic and aluminum industries as well as substantial gains in electronic and machine tool output.

Output of metal cutting machine tools is to reach between 190,000 and 200,000 in 1976—an increase of 1.4 to 1.5 times over 1971. This will include

Proving Ground for System Components in All Environments



High temperature fluid evaporation conducted in an environmental test area with operation at 800° F air to 100° F ambient



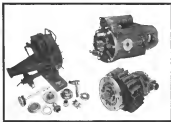
Control console for one of the tests and equipment test checks at Sundstrand's environmental lab



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Interrelated views of Sundstrand constant speed drive, gearbox, and hydraulic pump after operation at 800° F air to 100° F ambient

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15,000 speed/hour and aggregate six class tools. Production of some 50,000 fittings and proving machines in 1965 is called for by the plan.

Complete sets of electronic and semi-conductor machine tools will total between 250 and 271 in 1965 if the targets are met. Approximately 500 inches is considered for precision instruments in that year.

Aside from a brief statement on the ICBM, the secretariat plan contained no direct reference to the Soviet armament program. But Premier Khrushchev described in it as a speech made the following day at a reception for guests of military commanders of the USSR armed forces. In that he commented on the international situation but also referred to "aircrafts equipped with ballistic rockets and firing heads."

It is now enough to press one button and not only articles and means of communications of various staffs and headquarters but also whole cities are up in smoke, whole countries can be destroyed," the Soviet premier said.

The same only a few days after an article in *Sovetskaya Aviaciya* reported the West was badly arming on route of defense to protect itself against "a visible radiation blast" which it would face in case of war. Col. S. Rodin described national strength published in the Western press on reported fighter aircraft and guided missiles.

The arguments, calculations, and conclusions published in foreign aircraft periodicals suffer from a certain one-sidedness and bias, according to the Soviet targets of the aviation, as reported in reliable papers, objects of being no order nor results in better guided missiles for repelling the attacks of fighter aircraft," he said. But then in an undistorted manner, an article published in the Soviet press is achieving the products of the big, got companies which make planes and various aircrafts.

Transporter-Erector Designed for Rockets

Transporter-erector for large rocket engines new, under development will be built by the Melpack Corp., El Segundo, Calif., under \$125,000 contract from Rocket Chemical Corp.

Vehicular, a tractor with a special trailer, will be used to transport rocket engines to test sites and to erect engines in either horizontal or vertical position by electric drive. Control during erection of the engine will be accomplished with a combination of hydraulically assisted and electric lifts. Called the "transporter," the unit will be capable of handling engines up to 15 ft long and 55 in diameter and weighing 50,000 lb.

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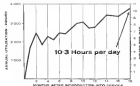
BRITANNIAS have now been operating for two years on some of the world's most exacting routes—in extreme climates—from diverse runways—on stages ranging from short inter-city hops to the longest transpolar flights.

How have they rewarded

Facts and figures of the operators themselves—these provide the conclusive evidence. They bear witness to the excellence of the basic Britannia concept. They prove the Britannia in service to be exceptionally reliable, capable of absorbing new traffic and extremely flexible in its use—profitable.

1 Reliable. Britannia's jet propulsion has established an all time record, with the first engine overhaul on the Proteus 700 has been raised by the Air Registration Board to 1,600 hours after only 48 months' service—a rate never before achieved by any engine piston or turbine. Engines routinely trouble-free—"El Al" New standard of mechanical reliability—newest approach to ideal propulsion unit for transport aircraft—"Aeromarine".

2 Steadily rising utilization rate. Here again aircraft reliability tells. After a year in service with BOAC, Britannia 190 series were achieving 6 hours per month per day and are now flying more than 10 hours—



2,150 hours per annum. After eight months in service with El Al, Britannias were already achieving 8.4 hours per day.

3 Attracting new traffic. On transatlantic routes this year Britannia operators have achieved some of the highest load factors ever recorded—despite a substantial drop for all carriers. During the first 4 months, BOAC's Britannias were 80-15% full.



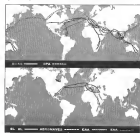
Since introducing Britannia El Al have tripled their share of transatlantic traffic, while Canadian Pacific on their transpolar Vancouver - Amsterdam route gained a 32% increase in scheduled traffic over the same period last year.

On commonwealth routes, Britannias have flown 400 million seat miles, 280 million passenger miles—a load factor of 70%.



THE OPERATORS?

4 Flexible. Britannias fly on stage lengths varying from 300 to 3,000 miles. Routes include: with BOAC, London - New York - San Francisco - London - Montreal - Chicago - Detroit - London - Bermuda - Caracas, on Africa route to Johannesburg, and on the Far East route to Tokyo, Sydney, Melbourne, with El Al Israel Airlines, Tel Aviv - New York, calling at Paris, London, with Aeromarine de Mexico, Mexico City - New York, and with Canadian Pacific Transpolar, Vancouver - Amsterdam, and Trans Pacific, Vancouver - Tokyo - Hong Kong. Britannia also fly on many other routes for the various airlines.



5 Non-stop transatlantic regularity. During the first six months of this year, El Al scheduled and made 181 transatlantic crossings. Only once did serious headwinds force an intermediate stop.

Then 100%, regularity continued when El Al were operating as early as five return services a week between Tel Aviv and New York with only three through El Al bi-monthly taken delivery of a fourth Britannia, services are to be extended further afield.

On their existing Commonwealth routes BOAC have achieved 98% regularity.

All these factors add up to— PROFITABILITY

The net total of success in all these factors is contained in one word: profitability.

El Al's experience bears this out. Three Britannias are operating at a 50% load factor and approximately 20% less than any previously registered.

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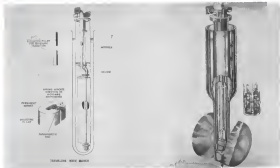


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AVIONICS



THEIR VIEW. Mass amplifier construction is shown for 3-head driver of two different types developed by Lucchi Laboratory. The design at left employs traveling wave principle. Unit at right is a single-tuned device. The new designs have extremely low noise levels.

Boom Predicted for Molecular Amplifiers

By Philip J. Klass

Washington—Impressive variety of Masers, parametric and other molecular amplifiers whose extremely low noise characteristics promise major improvements in the performance of radar, air traffic and communication systems, are under intensive investigation and development by more than a dozen major air manufacturing and research laboratories.

This was disclosed here during the Molecular Electronics Symposium sponsored jointly by Air Force/Air Research and Development Command and the National Science Industrial Association.

The symposium revealed the widespread interest and activity which has pushed the new molecular amplifiers from scientific curiosities to early experimental hardware in less than two years and is reminiscent of the tremendous enthusiasm which followed the development of the transistor 18 years ago. The molecular amplifier appears to be at roughly the same stage of development as the transistor was back in 1933-32.

Unannounced purpose of the symposium was to publicly launch a long-range

ARDC program and stimulate industry, focusing on the development of basic molecular new techniques for performing electronic functions that will provide order of magnitude improvements in reliability and reduction in size and weight to meet the needs of supersonic aircraft, missiles and space vehicles. USMC's parametric electronics were first revealed by Aviation Week last June 1 (p. 64) and June 16 (p. 241).

Contract Not Announced

However, ARDC spokesmen were unable to announce an Air Force award of a \$7 million research and development contract in molecular electronics because the contract had not been made final by the time of the symposium.

Symposium program was dominated by papers on Masers and parametric amplifiers, more of them dealing with high-powered phases of noise control to physicists than to engineers. While these devices typify the sort of performance advances that can be achieved by fundamentally new solid-state techniques, the program papers left many of the 250 attendees wondering if the symposium was not misdirected.

May Gen. M. C. Denier, USAF

director of research and development, called for dynamic and sophisticated developments to accomplish Air Force's mission. Col. C. H. Lewis, director of Aero-Electronics, ARDC headquarters, warned that a poor of downgrading science has been studied in attempting to further minimize conventional engine components and equipment. He called for more research on electronic phenomena and its relationship to chemical, physical, atomic and molecular properties so that materials can be created to perform as desired functions that now require collection of sophisticated equipment. Under such a philosophy, "electrons and passive components as no longer than tubes would disappear and be replaced by functional molecular blocks which are fabricated by growing in etching processes," Col. Lewis said.

Such techniques could reduce the size of engine equipment by a factor of more than 10:1, weight by more than 20:1, provide up to 17,000 "vacuum per inch," Lewis predicted.

Symposium speakers reported that the basic level Masers appear to have a clean-cut edge over the two-level Masers for most applications because the re-



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include the Fought Republic II Mustang, North American F-86, Boeing B-47, Lockheed F-104, Grumman F1H-10, Douglas XF-104, and the McDonnell F-101

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GENERAL ELECTRIC

may can operate on a continuous wave basis. For discussion of Maser trends, see *Aviation Week*, Aug. 16, 1957 (p. 76) and Aug. 26, 1957 (p. 91). A bonded Maser, however, can operate at frequencies above the X-band wherein present three-level devices operate. Dr. F. G. Cooke of Westinghouse Electric pointed out: "Two-level devices also can be extremely useful for investigating the properties of new materials and as a low noise source of extremely high frequency, microwave energy. Cooke said both types of Maser require cooling to extremely low temperatures, which tends to limit them to ground-based applications where size and weight are not critical factors."

Silicon Diodes

In the area of molecular amplifiers which can operate at room temperatures, a new parametric amplifier using silicon diodes (AW Aug. 4, p. 68) appears considerably more promising than the ferrite amplifier according to A. C. Fox of Bell Telephone Laboratories. Although ferrite amplifier has Q's of several thousand compared to Q's of only 10 to 20 for diode amplifier, the ferrite amplifier is apt to oscillate at some undesired frequency, due to accurate vibrating modes which are not fully understood. Fox reported:

The diode type of parametric amplifier also can be used by Dr. Leon B. Nagard of Radio Corp. of America. Because most figures of merit are sensitive depends upon the ratio of signal frequency to idling frequency (the latter is equal to the difference between pump frequency and signal frequency), use of simple diode amplifier is limited by difficulty of obtaining sources of extremely high frequency, operating passively. One way around this limitation is to utilize use of non-linearities of diodes to generate harmonics of the pumping power which makes it possible to advance effective pumping frequency, that is two or three times the actual frequency. Nagard and RCA has demonstrated this technique with diode amplifiers operating at 200, 300 and 400 Mc. Schwartz Dr. E. N. Sisson described the use of harmonic in general as a harmonic generator (inherent gain) which can be used to produce extremely high frequency power.

Number of Maser parametric amplifier programs currently being sponsored by Army's Second Group were briefly described by Martin Kitzman. They include:

- Bell Telephone Laboratories is working with Maser amplifying rate crystal. Diodes has exhibited 75 db gain with a 24 mc bandwidth and can be tuned over a 700 mc range, Kitzman said.
- Radio Corp. of America is investigating paramagnetic materials including mica that is doped with chrome, as well

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a use of superconductors for slant tracking.

• **Massachusetts Institute of Technology** is investigating two and three-level Mases.

• **Stanford Research Institute** is working with two-level giant diodes and other and tracking wave types with both sound around radio crystal. Kottman and the metric experts in its able to develop a device capable of handling "many tens of thousands of peak power."

• **Varian Associates** is studying pass-through materials, including stainless-steel doped with vanadium.

• **Spaulding Corp.** is investigating two and three-level Mases.

• **Hughes Aircraft**, working under Signal Corps sponsorship and with its own funds, has developed a two-level Mase. Major that operates at 10-MHz. Hughes also is designing a compact three-level unit for Signal Corps which is expected to have an overall equivalent noise temperature of 50 deg. Kelvin. Full of which comes from Mase crystal itself. Hughes is investigating indium salts and other Mase materials. Dr. T. H. Murren reported.

New Materials

University of Michigan's Willow Run Laboratories, under Army and Air Force sponsorship, also is investigating a variety of new Mase materials including gallium arsenide doped with chlorine and uniaxially grown graphite doped with cerium, according to Dr. C. K. Rader.

General Electric's Dr. Hwang Hsu described three novel parametric amplifiers which use internal feedback. One can be used to operate with pumping frequency that is considerably lower than signal frequency, instead of the usual reverse relationship. Dr. Hsu reported one unit had operated with 3-MHz signal frequency. By changing the amount of feedback it is possible to receive device's gain, decrease its bandwidth.

Other papers on parametrics from members of the audience, indicated that Air Force Cambridge Research Center, Naval Research Laboratory, Harvard University and Defense Intelligence Laboratory are also active in parametric amplified field.

Los Alamos' Dr. James W. Meier stated that the "next best" of interest in the application of parametric amplifiers to solid state Mases but all but exhausted the resources of basic research knowledge back up for its researchers." He called for expanded and continuing research into properties of new materials.

Dr. Meier also emphasized that use of extremely low-loss Mases makes the environmental noise of the risk of a radio or communication system, for

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which must be compared to promptness of mass consequences [AW Aug. 26, 1957 p. 104]. This means that sensitive times in defense and transportation must be held in extreme vigilance if there are not to affect mass panic.

Dr. Harvey Brooks, dean of the Harvard School of Engineering and Applied Sciences, told progress and understanding in scientific electronics would require investigations in five basic areas:

- Materials—preparation and properties
- Use of ultrahigh magnetic fields
- Bridging gap of knowledge between electronics and related in electronic active systems
- Micro-acoustics—the study of sound at microscopic wavelengths
- Extension of high precision techniques to extremely low temperatures



► **Components for A3J**—Problem of finding suitable location for electron-ray transmitters introduced as modern hardware is pointed up by the fact that the Navy's new North American A3J aircraft acquired 60 ECM antennas, although number has been reduced. Foreign suppliers of ECM equipment for A3J include Matsushita and RCA. North American Columbia holds ECM system integration responsibilities.

► **Sylvania Reveals ECM Facts**—Number of intercepting-sounding units and development programs in electronic countermeasures have been revealed by Sylvania Electric, including:

- Plans countermeasures study, in Army Ordnance Corps, on anti-aircraft missile system for which Sylvania is seeking design contracts
- AN-ALQ-6 airborne ECM recently developed by Air Force
- Propose to develop anti-jamming techniques for Ramo Air Development Center. Company also reports studies and design work for RADC on System 7156, system for detecting, intercepting and nulling out hostile Sylvania tactical ballistic missiles. Sylvania also holds contract for terminal guidance system for Army's Nike Zeus anti-aircraft missile program

► **Producing Airborne Fire Shield**—New technique for producing armor-plating equipment against missile attack and shrapnel which can infiltrate and melt 2 in. of aluminum has been developed in series of tests under are described in report by Wright Air Development Center. Report, designated DR 151005, priced at \$1.75, is available from Office of Technical Services Dept. of Commerce, Washington 25, D. C.

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MANAGEMENT
USAF Traces Ramo-Wooldridge Growth

Washington—Revealing portrait of the Ramo-Wooldridge Corp., financing of its remarkable growth in four years to a \$43 million business in 1957 and its ascendancy to Thompson Products as a dominant force in the defense industry is disclosed in a recently released summary of Air Force Service of Management of Ballistic Missile Program.

Survey was made only in 1954 prior to the company's decision to acquire its Space Technology Laboratories as a corporate wholly owned firm. It disclosed in and merge the resources of the company with Thompson Products to become Thompson Ramo-Wooldridge Inc. (AW July 7, p. 38; Aug. 25, p. 24).

Report reveals the complex corporate relationship that previously existed between Ramo-Wooldridge and Thompson Products by which its founders sought to retain complete control while the latter provided the bulk of the company's early financing.

Said details in the survey, original and present status of all Ramo-Wooldridge companies who owned more than \$20,000 annually as of Dec. 31, 1957, also are listed. Report discloses that Air Force has paid Ramo-Wooldridge a total fee of approximately \$3.1 million for its efforts on the ballistic missile program from 1951 through the end of 1957. This represents an average of 11% of the \$46.7 million in program costs acknowledged by the company during that time. Growth was especially rapid after Dec. 31, 1957, when it received a fee fixed at 14.3% of estimated cost, but the figure was reduced to 10% in Fiscal 1957, according to the report.

During the four-year period studied, military business represented approximately 97% of Ramo-Wooldridge's sales. Roughly two-thirds of this came from the company's ballistic missile management efforts. Approximately 60% of the firm's 3,100 employees at the end of 1957 were assigned to the Ballistic Missile program.

Company's net profit after taxes for the four-year period totaled \$3.1 million, an average of 34.4 cents per share, or about 10% of the \$90 million in sales. For the year 1957, net profits were \$2.9 million on sales of \$81.1 million, for a return of approximately 4.4%. The latter is comparable to rates of return achieved by aerospace manufacturers.

In the late summer of 1953, Dr. Dean Wooldridge and Sierro Ramo left Hughes Aircraft Co., along with other members of the top management, following disagreements with owner

Harold Hughes. Wooldridge and Ramo, top two executives at Hughes, generally are credited with having selected high-quality scientific personnel to the company in the past year period when played a major role in its management as one of the nation's largest aerospace manufacturers.

Wooldridge and Ramo approached J. D. Wright and H. A. Shepard, top officials of Thompson Products whom they had known previously, to see if their company would be interested in financing a new venture the two scientists proposed to form.

As Thompson Report reported last year (Oct. 13, 1954, p. 48), "Ramo and Wooldridge wanted a partner who would provide financial backing, business management assistance, yet not want any controlling interest in the new company, or return to the Thompson Products group."

Initial Capital

The two scientists originally each put up \$2,500 and Thompson Products contributed \$165,000, the company is reported. 49% interest in the new company while the founders and their key associates retained controlling interest. At this stage, the two founders were thinking of a small organization, possibly devoted to research and development, according to notes appended to the report.

It was not until several months later that the Air Force entered the picture. Under the Strategic Systems Committee (SSC) as across USAF's strategic missile program as a result of breakthrough in transcontinental weapons. The new company's total group of top-level executives, including its chairman and managing executives of a branch, under the newly formed Strategic Missile Division, Strategic Systems Committee was looking for technical support for its assigned task.

Wooldridge and Ramo, who had been working on the project, were looking for technical support for its assigned task. Wooldridge, then, in turn, led to the company's being named to Air Force's Ballistic Missile Division in May 1954, when USAF's launched its all-out ballistic missile program.

This called for expansion, and capital, for beyond nothing originally envisioned by company founders or Thompson Products. Funds on the order of \$20 million would be required during the next year or two.

Thompson Products could easily justify a modest \$165,000 investment without controlling interest in its own subsidiary, but an investment of

millions of dollars in a company controlled by two "outsiders" was neither matter. The principle needed to wait out an assignment which was not only satisfactory in these material interests but which also aimed to protect Air Force interests.

(Air Force had been extremely wary of only a year earlier that management took out at Hughes Aircraft might severely damage, if not destroy, the safe sale of Thompson Products for control system—although these two concepts did not adequately materialize.)

In return for additional financing, Thompson Products was given an interest in purchasing 70% of the Class B common stock, a class which elected five of the nine Ramo-Wooldridge board of directors. (Class A stock, which Thompson Products already held, had four representatives on the board.) However, the option could not be exercised prior to 1962-64 and had to be exercised in its entirety. (By this time, the ballistic missile program would be well along the road to tactical use.) The option further provided that Thompson Products could acquire a total of 51% of all common stock, including Class A.

Until the 1962-64 option period, a dividend income of the controlling Class B stock (15,107 out of 25,500 shares authorized) was deposited to a 10-year sinking trust with Sierro Ramo, Dean Wooldridge and Harold George Thompson, the three founders. Two of the three trustees could elect a majority on the board, thus controlling the company.

This, the Air Force report points out, insured that the company would continue to deal at least until 1964 with the individuals who were the best for the original source selection.

Out of this arrangement came a stock structure consisting of two types of preferred and one type of common stock. This was the structure as of Dec. 31, 1957.

- **Cumulative preference stock**, Thompson Products paid in \$1 million for all of the 48,000 shares authorized at \$100 per share plus dividends.
- **Preferred stock**, Thompson Products paid in \$120,000 for 3,000 shares outstanding at \$100 per share plus dividends at \$100 per share.
- **Class A common stock**, Thompson Products paid in \$43,312 for 21,506 outstanding shares of 14,000 shares authorized at \$100 per share plus dividends.

Thompson Products was authorized to purchase



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level flight speed of 426 knots, and has demonstrated a safe dive-speed of Mach 0.85.

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The design concept of the T2J stresses engineered safety. North American made exhaustive human-engineering studies and went into the field

to survey the preferences of flight instructors. The majority of the instructors, for example, said that they preferred a tandem seat arrangement. North Americans included this feature—but gave the instructor an unobstructed view by raising the rear cockpit so that he sits 16 inches higher than the student.

Instructors generally agreed that the desirable maximum approach speed for a trainer is 85 knots. NAA held the T2J's stall speed below 75 knots as an extra margin of safety.

North American's studies also showed that 80 percent of USAF and Navy aircraft accidents occur during landing and takeoffs—and that nearly all could be laid to loss of control. So the T2J was given a large tail for good stability and positive control at low speeds. Another outstanding safety feature is the NAA-designed deck-level ejection system, tested at speeds as low as 60 knots.

Engineered for easy maintenance

North American engineered the T2J for maximum reliability and ease of maintenance. It is made up of simple, conventional structures that can be conveniently fabricated. Off-the-shelf equipment was used wherever possible to ease logistics and hold down development costs.

The powerplant and auxiliary equipment is placed outside the primary structure. Large panels held by quick-opening latches

give convenient, ground-level access to bays on each side of the fuselage. Two panels on either side hinge upward to bare the engine. The T2J engine has been removed in seven minutes, installed in twenty. J-34 engine reliability has been confirmed by extension of service life between overhauls to over 1000 hours.

Wiring from cockpit consoles runs directly downward to the equipment bays. Each system is on the same side of the airplane as its console. This layout allows minimum length leads, makes it easier for maintenance crews to trace circuits and systems.

Small weapons loading

The T2J's wide range of mission capability includes initial check-out, instruments, navigation, formation, acceleration, and pilot proficiency training. For operational training, it provides gunnery, rocketry, bombing, and

five-target missions. Designed to operate without restrictions in any configuration—with or without tip tanks—the T2J is capable of simulating special weapons delivery techniques.

Optional ordnance packages designed for the T2J include gun packs, tow-target pack, 100-lb. practice bombs, M-5 practice bomb clusters, Type T-3 practice bomb containers, 2.25-in. rocket launcher assemblies, and 2.75-in. Mighty Mouse Aero 6A rocket packs.

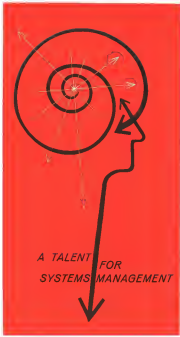
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addressed them to meet to maintain
45% control of all common stock
(Class A common stock).

•Class B common stock: Total of
12,140 shares outstanding of 25,000
shares authorized, for total of \$45,000
paid in. Total of 13,167 shares of
these outstanding were deposited in
trust for the bank.

In addition to the \$44 million
which Thompson Products received by
purchase of preferred stock, the com-
pany also signed a credit agreement
with Rano-Woodbridge by which it
agreed to loan the latter up to \$16
million on 10-year terms at 10%
interest. In 1972, Rano-Woodbridge had drawn
\$7.6 million from Thompson Products,
owed another \$5.5 million on loans
obtained from Nelson National Bank
& Trust Co. and Bank of America.

As of Dec. 30, 1972, the investor's
capital contribution of \$4.6 million

had expanded to a total shareholder's
equity of \$9.2 million, of which \$4.7
million represented retained earnings,
the Air Force spent industry.

Rano-Woodbridge owned 58% of total
Rano stock issued in the ballistic mis-
sile program, began 1959, with the
remaining 42% being governmental
owned. Total investment in property,
plant and equipment used for the mis-
sile program was \$32 million, of which
58% was Rano-Woodbridge owned,
28% loaned and the remaining 14%
government furnished.

Under the original terms of the
company's contract with the Ballistic
Missile Division, the company was spe-
cifically excluded from participating in a
major hardware contract in the ballistic
missile program, except with the ap-
proval of Assistant Secretary of Air
Force (Materials). Rano-Woodbridge
officials were in constant at the Air

Force as this point, to keep the com-
pany abreast of any technical
recommendations. Subsequently, Rano-
Woodbridge was low-bidder for design
and fabrication of data processing
equipment for use on an aerial guid-
ance system which American Rocket
Aerospace was designing for Titan, and Air
Force approval was given. The company
also won out over Radio Corp. of Amer-
ica, Eastman Kodak and General
Electric Machine Corp. for a Rano
Air Development Center contract to de-
velop intelligence data handling system
for Air Force Lockheed reconnaissance
aircraft (W3117).

However, in the ballistic missile pro-
gram, Rano-Woodbridge was a major
partner of the Air Force budget, Rano-
Woodbridge officials noted that they
represented for use on a major
portion of the future defense business.
The Air Force report says "the future

Air Force Ballistic Missile Timetable

Washington—Major milestones in the Air Force's ballistic
missile program, revealed by summary of Survey of Manage-
ment of the Ballistic Missile Program, recently released by
USAF's Inspector General (AFW News, 11, p. 14) include the
following:

•1945: Project MX-774, which later evolved into Project
Atlas, awarded to General Project subsequently named
Atlas "despite policy changes, design changes, major technical
difficulties and low priority," the report says.

•October, 1953: Strategic Missile Evaluation Committee
(SMEC) is created to review all USAF strategic missile program
because of a recent breakthrough which indicated feasibility
of small hydrogen-bomb warheads.

•February, 1954: Reports by both the Road Corp. and the
Strategic Missile Evaluation Committee (SMEC) conclude
that the Atlas intercontinental ballistic missile can be oper-
ated by 1962 and will be a new Air Force weapon to meet
the ICBM and accept a restricted program which should be
given highest priority and resources. Road Corp. earlier
had submitted reports which indicated the feasibility of inter-
continental missiles and had recommended a "flexible revision"
of Atlas program, according to the report.

•March, 1954: The report assigns top-level USAF study,
acceptance and authorization to serve performance require-
ments, maps high priority and establish a highly competent
military technical group, called AEG.
•April, 1954: Office of the Assistant Chief of Staff for Guided
Missiles is established with responsibility for control and direction
of the ballistic missile program at Air Force headquarters.
Joint Air Force Committee is organized by Dr. John von
Neumann to coordinate work of SMEC group and monitor
Atlas program progress.

•May, 1954: Highest Air Force priority is assigned to Atlas
program and establishment of a West Coast ballistic missile
field office is authorized. Its command is given authority over
all aspects of the program "to include development of a com-
plete weapon system, including ground support and the de-
velopment of reconnaissance operations, logistic and personnel
concepts." Name of field office, established July 1, 1954, was
later changed to the Air Force Ballistic Missile Division.

•May 15, 1954: Letter contract of the Rano-Woodbridge
Corp. to "perform technical services and furnish necessary
personnel, facilities and materials to conduct "Long Range

Artificial Studies of Weapon System" in support of recom-
mendations by SMEC. Rano-Woodbridge, which was formed
in the late summer of 1953 when its two founders left top
technical positions at Hughes Aircraft, had provided report
to the SMEC group design late 1953 in the course of its
ballistic missile study and had recommended a 12-month
program of technical evaluation and system analysis of Project
Atlas. Thus, the Inspector General's report points out, coupled
with Rano-Woodbridge's "exceptionally detailed group of
recommendations and a potential for expansion, its capacity
then demonstrated conclusively," made the firm "the logical
choice to provide the selected management group authorized
by the Chief of Staff."

•July 20, 1954: After review of the Atlas program, Inter-
service Advisory Committee concludes that "Control had not
demonstrated required weapon system management capability,
that Ballistic Missile Division was not equipped to study
program effectively and that a division must be created to
assign system responsibility to new organization." The Ballis-
tic Missile Division subsequently recommended that it assume
overall weapon system responsibility and that Rano-Wood-
bridge provide technical assistance and system engineering.
This plan was approved by Air Force officials, including As-
sistant Secretary of the Air Force for Material, Roger Roys.

•During 1955: Air Force ballistic missile program and Ballis-
tic Missile Division responsibilities are expanded to include an
intermediate ICBM. Project SSN-60 is launched as Atlas,
the initial ballistic missile program which is now the Titan
ICBM, the reconnaissance satellite, W3117, now the Lock-
heed Sentry, the solid-propellant ICBM, later expanded to the
present Minuteman ICBM program, and the early warning
portion of ballistic missile defense, subsequently transferred
to Air Vehicle Command.

The goal with which USAF moved on its Titan ICBM
program is authorized by the following language:

•Nov. 25, 1955: Ballistic Missile Division authorized to pro-
ceed with Titan ICBM, construction included its proposed
hardware.

•Dec. 5, 1955: Proposal for Titan submitted.
•Dec. 25, 1955: Selection of Douglas Aircraft approved by
Air Force Secretary Donald Douglas.

•Dec. 25, 1955: Contract for Titan signed with Douglas.
•Jan. 15, 1956: Titan defense designation begins.

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of the Ranso-Woodbridge Corp. involved executives because of its expressed desire to participate in the competition for ballistic missile hardware contracts.

The agents have been most enthusiastic for the recent action in spinning off Space Technology Laboratories (STL) as an independent corporation. STL will be wholly owned by Thompson Ramo Wooldridge Inc., but the latter will have no representation on its board of directors.

Pacific Semiconductor Inc., established in June, 1954 by Ranso-Woodbridge, as a subsidiary to develop and produce diodes and transistors, has been unable to date the report since.

Ranso-Woodbridge, and Thompson Products have received \$6.9 million in the form of stock purchases and loans to the STL subsidiary since its formation. As of last Dec. 31, the company had reported a net cumulative loss of \$4.8 million—an indication of the current cost of getting into the highly competitive semiconductor business.

All of the common stock in STL was owned by Ranso-Woodbridge, with Thompson Products holding preferred which was convertible into common stock after Feb. 1955, and which, after conversion, would give Thompson Products the right to elect three of the seven board of directors. As of Dec. 31 the subsidiary had a \$3.5 million loss outstanding from Thompson.

In the process of assembling a staff of technical people, Ranso-Woodbridge noted all possible experiences, including money, in attract scientists. (The company at that time was frequently criticized in industry circles for its liberal salary policies.)

With this background to meet the sales, Spens followed in the Air Force report appear surprisingly modest for top-level scientists in today's market. Only 11 out of 50 Ranso-Woodbridge scientists working on the ballistic missile program were reported to be earning \$70,000 or more per year as Dec. 31, 1957. This does not include 12 company officers, including Ranso and Woodbridge, and nine other scientists in other Ranso-Woodbridge divisions whose 1957 income also exceeded \$70,000.

Woodbridge and Ranso, who each drew salaries of \$57,500 during company's last year, were listed for salaries of \$59,324 each in 1957. Vice President Harold Geoghegan, who started at \$25,000 in 1954, now drawing \$42,500 in 1957. Dr. Louis Dunn, former manager of the Space Technology Laboratories Division and now president of Space Technology Laboratories Inc., received a salary of \$37,500 in 1957, while Dr. R. F. Maffett, now executive vice president of STL, drew \$35,000. In addition to these salaries, total

bonuses of \$71,940 were distributed to key employees in 1957, with no individual receiving more than \$15,000. That added compensation was not claimed for reimbursement under the company's GIFF provision with RAIL.

Under terms of the recent merger, former Thompson Products President J. D. Wright becomes chairman of the board and chief executive officer, while Dr. Woodbridge becomes president of the combined company. Dr. Ranso retains the title of executive vice president for the merged firm and F. C. Crawford, former board chairman of Thompson Products, becomes chairman of the executive committee.

Merge was carried out through the exchange of 260,176 shares of Thompson Products common stock, representing about 51% of its now outstanding shares, for 18,750 outstanding shares of Ranso-Woodbridge Class B stock not already held by Thompson Products. The latter already owned all of Ranso-Woodbridge's other shares of outstanding stock. The exchange also ran 15,671,625 shares of Thompson Products common per share of Ranso-Woodbridge Class B stock. At the current market price of around \$65 per share for Thompson Products common, the share of Ranso-Woodbridge stock was worth approximately \$904.

At current market price, Ranso-Woodbridge stockholders received approximately \$16.9 million for their equity in the company. Thus, again, Thompson Products paid its own stockholders a recent report, was believed to be "unbelievably low" than the price it would have been required to pay if it had waited until the mid-1960's to exercise a previous option.

A total of 14,500 shares of the 18,750 outstanding Ranso-Woodbridge Class B stock was held by four Ranso-Woodbridge officers and directors: Woodbridge, Ranso, Geoghegan and Dr. Ralph J. Johnson. Thompson Products stockholders report reveals that it had acquired 1,750 shares of Ranso-Woodbridge Class B stock since 1955, principally from sales at prices ranging from \$150 to \$275 per share.

The report also says that Ranso, Woodbridge and Geoghegan now are among the largest single stockholders of the merged company, all three holding large control blocks shared by Crawford and Wright Holdings, and approximately equal value, for the four Ranso-Woodbridge officials are:

- Dr. Seneca Ranso: 44,499 shares, \$3,152,495.
- Dr. Dunn Woodbridge: 45,035 shares, \$3,027,275.
- Harold Geoghegan: 38,337 shares, \$2,479,955.
- Dr. Ralph Johnson: 11,637 shares, \$900,765.



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ALOUETTES owned by Petroleum Helicopters, Inc., have carried more than 1,000 passengers to and from offshore oil rigs since June.

Alouette Gains Stature in Offshore Use

By Erwin J. Balkin

New York-based performance of a pair of French-designed Sikorski Alouette II turbopropeller helicopters on the job for the offshore oil industry in the Gulf of Mexico is leading to fast spreading acceptance of the relatively new, rotary-wing aircraft by the vast industrial sector.

Indications are that by the end of next year some dozen "Whirlfins" as they are nicknamed, will be working in the area.

This production comes from veteran helicopter operator Robert Suggs, president of Petroleum Helicopters, Inc., which has a fleet of approximately 16 Sikorski working in the Gulf area and in South America. Petroleum Helicopters' first delivery of its first Alouette II came June 19 and the second on Aug. 22, and is considering eventually replacing its Bell 47s with the new Sikorski.

First Commercial Purchase

Petroleum Helicopters is also likely to be the first commercial purchaser in the U.S. of the Sikorski two-place, tip-hoisting helicopter, also marketed here by Republic Aircraft Corp. under a licensing agreement with the French manufacturer. The company plans to use these as backbones of operations, claiming 79.90 mph on the Gulf, replacing Bell's one-lane design. Suggs says it is studying use of the D-19 as well as general operations a dozen

stations of this capability was provided here at the factory during a recent trip to New York.

Key factors in what Suggs terms "unsolicited acceptance" of the Alouette II by the oil industry include:

- Speed, the Alouette providing average of some 50 mph on 70 mph flights from land base to the rigs, at which 50 mph is over water, compared with 40-60 mph for the Bell 47. Productivity factor of reducing the time passengers spend on what has been a most important reason for favoring the new turbopropeller helicopter, Suggs told Aviation Week.

- Alouette, being larger than the Bell 47, has the appearance of being more rugged, according to customer comments, and the French machine's more powerful turbine engine also has been the subject of remarks by passengers who say that they favor the Alouette over the Bell, according to Suggs. Thus far, with only two Alouettes in his total fleet, most of them he has been in transporting industry executives and engineers. Suggs reports that requests for transportation in or from the rig usually specify that a "Whirlfin" be available instead of a "Diddle," which is the nickname for the 47.

- Fuel availability is another important factor in the Alouette's growing popularity. Oil companies are conscious of the hazards on their operations as well as to permit survival of an aviation fuel aboard their rigs, which sometimes cutting off fuel of petroleum oil.

cost since they must carry enough fuel for a round trip. However, because it is a common time around the industry's property and the Alouettes are to be based aboard the rigs if necessary. Bell 47s generally carry two passengers per trip, Suggs reports, often one, but the Alouette's standard load is three passengers and it can carry four if the aircraft makes a fuel stop on the beach just before landing over the water. One oil company, has specified the Alouette because of larger capacity, since it assumes would require use of two Bell 47s where one Alouette can adequately handle the job.

Customer Cost

Cost to the customer for Alouette service is similar to that for the Bell 47. Alouette actually has higher operating cost, but because flying time is so much less it can make more trips and the customer pays for flying time.

Suggs points out that the Bell 47 has done an extraordinary job in developing and handling the offshore oil industry's transportation needs. However, he says the Alouette is gaining rapidly in popularity because it is a newer, higher-performance aircraft and passenger replacement of some patterned helicopters is being planned in the future. Suggs predicts that in approximately a year perhaps 75% of helicopter operations in the Gulf area will be handled by turbine-powered Alouettes.

Petroleum Helicopters has put in

more than 300 flying hours on its number one Alouette since delivery in June, almost that much on the second ship. Alouette are averaging approximately 34 hr. a day. From delivery time to the end of October, Suggs' number one has accumulated 297 flying hours on 340 flights and carried 334 passengers plus cargo. Availability now is 94%. Ship number two at the end of this period had flown 182 hr., made 161 flights and carried 474 passengers plus cargo. Availability was 91%.

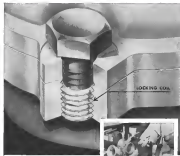
Maximum distance of flights has been 170 mi. and maximum endurance time 3 hr. 50 min. Suggs reports that of 285 days the Alouettes have been available, they were not used for a total of 25 days for both aircraft due to weather, maintenance and similar reasons. Ships have been averaging 88% availability, he expects that to go up to his maintenance staff's learning curve improves.

One Alouette flew 150 hr. in 30 days, covered 16,400 mi. and on one trip carried more than 750 lb. of cargo. 77 mi. and in 55 min. he rates. Helicopter made landings and takeoffs from the rig in winds exceeding 35 kt.

Suggs says that the aircraft probably could have shown even higher availability in actual operating period except for an extra safety factor. Petroleum Helicopters and while it learned how to handle the new aircraft. For example, if the lightning problem arose on a landing, a line could be connected, the Alouette would be "stowed down" and a Bell substituted for that flight.

Suggs also pointed out that helicopter being inherently is no problem with the turbine-powered helicopter, while, on a per se, need for application of heat also results in subsequent power losses. Control simplicity too. Thrust is steady is another feature; pilots need to make up in maximum speed, maneuver time, which is the most efficient condition for the Alouette and provides it with the most useful payload.

Petroleum Helicopters maintains a 30-day level of operation. Republic is providing it with 24-hr. service as well and, he stated. Company has a preliminary exchange program where if the operator goes Republic 48 hr. notice, it can have a one-time engine at Petroleum Helicopters' Mangrove City, Calif., base with time to spare. Engine carries 50-hr. warranty. Engine changes take approximately 30 min. Alouette's Turbopropeller powerplant currently has time between overhauls at 215 hr., formerly 260 hr., and this is expected to go to 350 hr. in 2000. Main rotor blades, less than 100-hr. replacement at 600 hr., now go to 1,100 hr., but rate, which formerly came off at 100 hr., can go to 530 hr.



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cently such too. The gas coming from the gas tank and all instruments were proper and normal during each operation.

A careful inspection of the entire landing gear system showed that it was operating properly. All dimensions were found to be within their respective tolerances. Rejection of cables and pulleys was proper and no landing or maintenance could be found. With the exception of the above noted damage, all components of the system were in good condition.

It was determined that all damage noted was the result of the collapse of the landing gear. No mechanical defect or irregularity could be found which could have interfered with the proper operation of the landing gear. In addition, no malfunction in the operation could be observed which would cause the landing gear to operate improperly.

The aircraft was then test flown and the landing gear system tested. Each time the gear was extended it would lock down properly and the warning system indicated correctly. In several of the tests the aircraft landed on the ground. The POSITIVE LOCK position before the landing gear was lowered. In some cases the strut and lock nut were tested against the cable tension of the lock actuating mechanism and prevented the lock to go into itself controls in the strut and lock nut and then lock the gear down normally.

The crew stated that the flight had been normal. They said that in preparation for landing at Chino later they had followed the usual checklist. The landing gear was lowered and each pilot checked visually to see that the gear was fully extended. The hydraulic pressure was checked to hold up to the landing gear system to 700 lb./sq. in. The mechanical lock was checked.

After this engine and the gear indicator lights were returned to NEUTRAL. Both pilots stated that after the gear was extended the green "gear up" light indicated the landing gear was down and locked. Further, that both throttles were closed as the aircraft landed. Both pilots stated that the gear had not been locked at that time the landing gear warning horn should have sounded. At no time during the landing did the engine, in the landing, the warning horn did not sound. No indication of any gas condition. However, simultaneously with the collapse of the gear at the time the warning horn sounded and the red warning light came on.

Both pilots were also positive that the gear had been properly extended and locked. Both stated that the landing gear controls had not been moved after the gear was lowered and locked and that no conditions were noted since the gear collapsed at the time.

ANALYSIS

The landing gear on the DC-3 is a well known and well understood design and its reliability has been proved by many years of successful use. It is also designed in operation, providing all cables, pulleys, struts, etc., are properly rigged and maintained as are used.

The examination of the landing gear on N 3747A showed that no defect existed in the system prior to the collapse.

Both safety factors were found as the



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POSITIVE LOCK position with the latch withdrawn. In addition, the safety latch control on the cockpit was latched to the floor. In order for both gears to engage as they did both safety latches would have had to have remained in the UP LATCH position. This possibility is extremely unlikely and so evidence was found on other latch mechanisms which could have caused a double failure such as this. In addition, the latch spring mechanism is actuated by a cable and pulley arrangement such as one or both of the latches had hung up it would have required considerable pressure then released force to latch the cockpit control latches, even if it were about negligible clearance one or both latches had hung up and the cockpit control could be properly latched, the red "Unsafe" warning light would have come on in the cockpit and the warning horn would have sounded. This could also have been evident during the maneuvers of the aircraft because for each to have been possible the rigging of the landing mechanism would have had to have been improper. It was not.

It would have been impossible for the landing gear to retract only the safety latches properly engaged on the main deck without considerable damage to the latch mechanism in the latches. The only damage noted was a slight leak in the actuating fluid and leak in the right gear. This damage occurred at the gear track. Thus it was found up beyond its normal travel by the slotted seating of the servo. Here again even if this damage had been present prior to the collapse it would have been evident. First, if the gear would not lock down, the red warning light would have stayed on and the warning horn would have sounded. Second, the left landing gear would not have been affected and would have locked down safely.

Excessive Pressure

The hydraulic down line which was found ruptured was determined to have burst in a result of excessive pressure. This line could not have failed before the gear was extended by landing. If it had, where the pressure-sensing device was placed in the DOWN position the hydraulic fluid in the main lines would have been lost. With the device in the DOWN position the hydraulic fluid level was constant. In addition a small amount of hydraulic fluid did not leak through in the down line nor burst under the pressure on the wing, indicating that the line had burst after the aircraft had reached this point.

The failed hydraulic down line was the only one the way this accident happened. In order for the line to have ruptured it had to be landing gear selector handle had to have been in NEUTRAL with the latches in the UP LATCH position. In any position other than NEUTRAL, excess pressure would build up in a result of the partial collapse of the gear, would have been relieved through pressure relief valves. Further, if the safety latches had been engaged in the lock and down the gear stream would have been prevented by the mechanical lock.

In summary the Board concludes that for the accident to have occurred in the manner indicated by the over a number of simultaneous malfunctions would have had to have occurred. First, both safety

latches would have had to hang up and then not function properly after the collapse. Second, the cockpit latch control would have had to have been engaged and then have remained stuck when the latches were found to be in the lock down position after the gear had collapsed. Third, the three actuators operating the landing gear warning system would have had to have not only failed but would have had to be secure several functions giving a gear unsafe light instead of a red unsafe light. This condition also would have had to have occurred only when the aircraft rolled. Fourth the landing gear warning horn would have had to have been responsive and then have sounded itself.

In the absence of evidence to substantiate any such malfunctions, the Board must conclude that no mechanical failure occurred which contributed to the cause of the accident.

FINDINGS

On the basis of all available evidence the Board finds that:

1. The aircraft commander, and crew were properly certified.
2. The flight was conducted with no mechanical difficulties were experienced by the crew.
3. According to the crew the landing gear was extended and locked properly at the altitude was prepared for landing and a gear "gear ok" indicator light came on in the cockpit.
4. A normal landing roll without was made.
5. At the aircraft approached the ramp, both main gear collapsed.
6. Several simultaneous malfunctions would have had to occur for the landing gear to collapse while a "gear ok" condition was indicated.
7. Examination showed there was no real weakness in the landing gear, landing gear safety latch mechanisms, or landing gear warning system.

PROBABLE CAUSE

The Board determines that the probable cause of the accident was that the cockpit landing gear safety latch lever was not correctly or inadvertently moved to the UP LATCH position while the aircraft was being landed to the ramp.

By the Civil Aeronautics Board:
James C. Barber
Chairman
Harold D. Dwyer
G. Joseph Minton
Leon J. Hester

SUPPLEMENTAL DATA

The Civil Aeronautics Board was notified of the accident on the afternoon of Dec. 7, 1957. An investigation was immediately initiated in accordance with the provisions of Section 701 (a) (1) of the Civil Aeronautics Act of 1934, as amended. Expedient action by the Board was taken in the CAA office in Washington, D. C., on Nov. 12, 1957.

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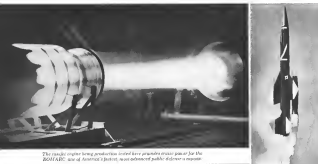
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FLIGHT PERSONNEL

Capt. Harold Cox Kelly, age 43, was employed by Piedmont Airline, May 25, 1943. He had accumulated a total of 12,119 flying hours, of which 8,331 were in DC-3 equipment. Capt. Kelly held a valid commercial certificate with an airline transport rating and was rated in the DC-3. His latest aircraft proficiency check was May 23, 1957. He had been on duty since April 24, 1957. He had passed his CAA check of May 20, 1957. Capt. Kelly had flown 41,000 in the preceding 24-hour period and 2,100 in one week in the preceding week.

Capt. Fred Knick, age 29, was employed by Piedmont Airline, May 17, 1951. He held a valid second certificate with commercial privileges, airplane single engine land, and instrument ratings. Mr. Knick had a total of 2,086 flying hours, of which 1,871 were in the DC-3. He had an aircraft proficiency check and instrument certification was in August 1957. His first CAA check was passed Jan. 15, 1957. Mr. Knick had flown 45,000 in the preceding 24-hour period and 2,100 in one week in the preceding week.

THE AIRCRAFT

DeSinger DC-3C, N 1547A, was manufactured January 1944 and was registered in the U.S. Navy Dept. and leased to Piedmont Airline, Inc., Winston-Salem, N. C. The operator had a total of 2,360 flying hours, and a total of 1,620 flying hours were recorded. The total time on the landing gear was 7,332 and the total time since the No. 4 maintenance check, which was the last landing gear maintenance was performed, was 676. Several maintenance problems were corrected at that time. The landing gear system and the landing gear system were inspected and passed on the last No. 2 inspection performed on Sept. 21, 1957. The aircraft had flown for 1,000 hours since the last No. 2 inspection. The aircraft was equipped with Pratt & Whitney engine model R1140-9 and Hamilton Standard propeller model 21E30.

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Qualifications: B.S. or Advanced Degree in E.E. or A.E.

RADAR ENGINEER to develop advanced levels of present techniques and develop new concepts of providing topographical pictures for advanced airborne and ground systems. To design airborne radar pulses, microwave and deflection circuitry to analyze Doppler radar systems in order to determine theoretical accuracy and performance limitations.

Qualifications: B.S. or Advanced Degree in E.E. and 3 to 5 years' experience in radar systems development, including design equipment and circuits, control consoles and Doppler or search radar design.

CIRCUIT ENGINEER to undertake advanced circuit design based on transistor logic for digital systems; to review new circuits for application in digital control systems; to define basic techniques for improving performance characteristics; to participate in advanced analytical studies associated with application of transistor circuitry to pulse and digital systems.

Qualifications: B.S. or Advanced Degree in E.E. and 2 years' experience with pulse circuitry, transistor circuit design, or digital techniques.

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